JUVENILE MORTALITY RATIOS IN ANGLO-SAXON AND MEDIEVAL ENGLAND:

A contextual discussion of osteoarchaeological evidence for infanticide and child neglect

Amy Charlotte DAPLING

Submitted for the degree of

Doctor of Philosophy

Department of Archaeological Sciences

University of Bradford

2010

Abstract

This thesis presents an osteoarchaeological analysis of juvenile mortality profiles questioning the speculations made by some archaeologists that the under-representation of infants from Anglo-Saxon and medieval burial populations could be due to the practice of infanticide in England during these periods. Morphological and metrical age estimation and sex assessment methods are used to determine the age-at-death and sex of 1275 children from fifty-three Anglo-Saxon and medieval sites located in southern England. The age and sex distribution of the Anglo-Saxon and medieval children under six-years-old are then compared with age-specific United Nations demographic statistics see to whether or not a normative mortality profile is presented by the archaeological populations. This study identified an abnormal age-at-death distribution for the early Anglo-Saxon perinatal individuals. Excess female mortality was observed for the perinatal individuals from all three periods; early Anglo-Saxon, late Anglo-Saxon and medieval, and for the neonatal and infant individuals from the early Anglo-Saxon and medieval periods. The results of this osteoarchaeological analysis are discussed in conjunction with a review of the Anglo-Saxon and medieval documentary evidence which examines the possible social and economic motives for infanticide. Whilst this analysis of the historical sources revealed laws and penitentiary warnings against the neglect and deliberate murder of infants, the late Anglo-Saxon and medieval documents provided little evidence to suggest the social devaluation of women that would support a hypothesis of preferential female infanticide. There are few surviving early Anglo-Saxon documents however, so the significance of the abnormal mortality profiles from this period is considered.

Keywords:

Infanticide, Anglo-Saxon, Medieval, mortality, sex assessment, infant.

Acknowledgements

This research could not have been completed without the assistance of countless curators across the country who replied to my many emails searching for suitable Anglo-Saxon and medieval study material. Particular mention goes to those individuals who were able to accommodate my study and provide access to the collections; David Rice at Gloucester City Museum, Tim Pestell at Norwich Castle Museum, Esther Cameron at the Oxfordshire Museums Service, William White at the Museum of London, Jane Hill at the North Somerset Museum, Alison Brookes at the Corinium Museum Cirencester, Mercedes Okumura at the Duckworth Laboratory, Helen Rees and Robin Iles at the Winchester Council Museums Service, David Allen at the Hampshire Museums Service, Benedikte Ward of Archaeological Investigations, Quinton Carroll at the Cambridgeshire County Council Archaeology Section, Robert Kruszynski at the Natural History Museum, Andrew Richardson at Canterbury Archaeological Trust, Jo Buckberry at the Biological Anthropology Research Centre, and Sarah Inskip at the University of Southampton. Thanks should also be given to Tony Waldron for providing permission to study the unpublished Cherry Hinton Osteology report. I am indebted to Laura Calderwood for her assistance with the inter observer study. I am also very grateful for support of my supervisors Dr. Holger Schutkowski and Dr. Jo Buckberry who helped keep this research on track.

This research was made possible through a Doctoral Award from the Arts and Humanities Research Council.

List of Contents

List of Figures

List of Tables

CD Contents

Chapter 1

Introduction

Introduction and Aims

A common observation from the excavation of Anglo-Saxon and medieval cemeteries in England is that the burial populations generally reveal a lower proportion of infants and juveniles than would be expected from a preindustrial society (Daniell 1997: 125; Devlin 2007: 54; Hines 2002: 96; Lucy 1994: 26; Molleson 2003: 122; 1991: 118; Stoodley 1999: 106). This dearth of infants from cemetery populations coupled with the higher number of males than females reported from both archaeological and documentary sources has led some excavators to speculate the possibility that widespread infanticide, especially of girls, may have occurred in England during the Anglo-Saxon and medieval periods (Arnold 1988: 185; Boswell 1989: 263; Daniell 1997: 125; Molleson 2003: 122; 1991: 119; Morton 1992: 52; vom Saal 1994: 59). This thesis aims to question these assumptions through the osteoarchaeological analysis of subadult mortality profiles from Anglo-Saxon and medieval burial populations.

Many researchers acknowledge that infanticide, the killing of babies at or soon after birth, is an old and almost universal custom that has been practiced on every continent and by people from every level of cultural complexity (Cowlishaw 1978: 262; Kellum 1974: 367; Lillehammer 1989: 100; Wilson 1988: 762). Infanticide can compromise a number of behaviours which are not necessarily mutually exclusive including: deliberate killing, placing the child in a dangerous situation, abandonment where the child might survive, ‘accidents’, excessive physical punishment, lowered biological support and lowered emotional support (Scrimshaw 1984: 444; 1983: 248). In societies where infanticide is not socially sanctioned, individuals may still overtly, covertly, or unconsciously choose to reduce their family size or influence spacing through behaviourally induced infant mortality (Scrimshaw 1983: 258). Previous osteoarchaeological investigations have examined the possibility of infanticide in Roman Britain (Mays 2003b; Mays 1993; Mays & Faerman 2001), and historians have discussed the documentary evidence detailing the widespread practice of infanticide in England during the seventeenth to nineteenth centuries (Dickinson & Sharpe 2002; Gowing 1997; Hoffer & Hull 1981; Langer 1974a; Sauer 1978; Williams 2001). However, little is known about the practice of infanticide in England between these studied periods, a fact that should be addressed before archaeologists continue to make assumptions regarding the under-representation of infants from Anglo-Saxon and medieval contexts.

The previous research on infanticide within the archaeological literature has focused on the age-at-death profile of perinatal infants as it is argued that the practice is usually carried out immediately after birth. In the present study it was thought that confining the analysis to just the perinatal individuals from the archaeological samples could be restrictive, as this would prevent any investigation into passive infanticide, the term used to describe the deliberate biological or emotional neglect of children (Scrimshaw 1983: 248). The question of the practice of infanticide in archaeological societies can be further explored through the examination of the sex distribution of the mortality populations. This is because within many societies children of one sex are valued more than the other, and since patrilineal descent is the more common pattern of inheritance in many societies, males are usually preferred (Saunders & Barrans

1999: 189). Therefore, when such societies practice infanticide, more girls than boys are likely to be victims (Mays & Faerman 2001: 555; Molleson 1991: 121), and so skewed sex ratios resulting from frequent female infanticide should be archaeologically detectable (Meindl & Russell 1998: 377). This project aims to assess the age-at-death and sex of Anglo-Saxon and medieval subadults using morphological and metrical methods in order to analyse the mortality profile of the children under six-years-old for any abnormalities that could be indicative of deliberate infanticide or neglect.

There are complications to any study investigating mortality patterns because the probability of dying is not constant with age, nor is it equal amongst the sexes (Chamberlain 2006: 25; Saunders & Barrans 1999: 189). It is, therefore, necessary to first discover what constitutes a normal mortality pattern before we are able to interpret any abnormalities. The risk of mortality is the highest in the days immediately following birth, when the newborn infant is particularly vulnerable (Barley 1995: 179). However, from the moment of conception and throughout the human lifespan, the mortality rate for males is significantly higher than it is for females (Bakwin 1928: 91; Ciocca 1940b: 60; Cowgill & Hutchinson 1963: 425). This is in part due to the greater biological vulnerability of males but also a factor of the higher ratio of male conceptions and births compared to females (Saunders & Barrans 1999: 189). This would suggest that in a normal mortality situation we would expect more male than female children to be recovered from the archaeological record. On the other hand, if there are a disproportionately large number of female children within the archaeological populations it may be possible that an abnormal mortality profile has occurred.

To enable any interpretation of the mortality profiles of the archaeological populations we need to first define a normal mortality profile. This research will use age-specific United Nations demographic statistics to create reference mortality profiles that will be compared with the Anglo-Saxon and medieval populations. This should indicate whether or not a normative mortality profile is presented from the Anglo-Saxon and medieval archaeological populations. The results of this osteoarchaeological analysis will be discussed in conjunction with a review of the historical sources that considers the possible social and economic motives for infanticide within Anglo-Saxon and medieval society. This will examine whether or not we can infer the practice of infanticide from the representation of subadults from the Anglo-Saxon and medieval burial populations.

The Interpretation of Anglo-Saxon and Medieval Documentary Sources

The present study aims to review the documentary sources from the Anglo-Saxon and medieval periods for anthropological parallels to evaluate the osteoarchaeological evidence. It is clear, however, that any documentary evidence should be used with caution due to the potential prejudice and biases of the texts (Crawford 1999: 35; Cunliffe 1993: 266; Gordon 1991: 146; Williams 2006: 14). This is particularly true of the documentation of the Anglo-Saxon period where there were great changes brought not only to the social and economic structure, but also to the religious beliefs which saw pagan values overtaken by Christian dogma (Crawford 1999: 33; Williams 2006: 14). There are very few documents from the early Anglo-Saxon period and it would appear as though it was not until after the adoption of Christianity that any mass of legal custom was written down (Campbell 1986: 131; Crawford 1999: 41;

Whitelock 1979: 361). However, we should not forget the possibility that earlier documentation may have existed but deliberately supplanted by later authors.

The documentary evidence falls into several major categories including law codes, chronicles, poetry (secular and religious), hagiography (the *Lives of the Saints*), wills and charters (Crawford 1999: 33; Williams 2006: 14). The various literary genres will produce particular difficulties of interpretation (Crawford 1999: 33). For example, whilst the Anglo-Saxon law codes can provide some interesting insights, only a small and disproportionate number survive (Crawford 1999: 41; Whitelock 1979: 362). Any study of the Anglo-Saxon law codes must also recognise that conclusions can only be directly related to small areas of the country, although they may have represented countrywide customs (Crawford 1999: 41). Furthermore, the written laws are generally enactments, when it was necessary to re-state rules that were being disregarded, to clarify matters on which there could be uncertainty, or to modify existing rules (Crawford 1999: 41; Whitelock 1979: 362). A great amount of customary law, such as that relating to inheritance and other family matters, was probably never put into writing at all, being too well known and too fixed to require written statement (Whitelock 1979: 362). This gap can partly be covered by examination of the charters and wills which provide occasional glimpses of family structure and attitudes towards offspring (Whitelock 1979: 369). However, as the transactions within charters and wills usually involve the elite, they are not representative of the holdings of the ordinary (Crawford 1999: 44).

The hagiographical texts provide rich and colourful sources of semi-historical insights into Anglo-Saxon and medieval society and while the saints themselves may be drawn from the upper echelons of society, their interaction with their social inferiors extends the range and the historical value of these sources (Crawford 1999: 33; Gordon 1991: 146). However, the *Lives* of the saints were written in a formulaic structure used to edify and entertain the populace: they competed against secular folklore and epic sagas to lure towards the Church with its martyrs and holy men, and therefore contain layers of meaning within any action (Crawford 1999: 35). Thus the documentary evidence presents a far from complete picture of Anglo-Saxon and medieval life, but it should provide some interesting social commentaries that can be discussed in conjunction with the osteoarchaeological data.

Thesis Structure

This thesis begins with a discussion of the background literature regarding the function of infanticide in human society which is presented Chapter 2. This examines the motives and methods for purposefully neglecting and killing children observed from societies around the world. The historical context of the practice of infanticide and neglect of children in England is discussed, including a review of the development of English legislation against the crime. The issues of demographical analysis are considered in Chapter 3 which explores the factors that affect the age and sex composition of the mortality profile. This includes an in-depth discussion on processes affecting the human sex ratio, examining the role of genetics, biological evolutionary processes and culturally defined gender preferences.

The following few chapters consider the customs, attitudes and ideologies within Anglo-Saxon and medieval society that impacted on the cultural and economic value of children and women and which could possibly have enabled infanticide to be seen as more acceptable in the eyes of society. Chapter 4 reviews the parental relationship towards children within Anglo-Saxon and medieval society, in particular the position of the disabled, illegitimate or unbaptised child. Chapter 5 investigates the social value of women in context with their economic capabilities, marriage agreements and subsequent transition of property, and rights to inheritance. Chapter 6 reviews the capacity of the Anglo-Saxon and medieval society to respond to pressures of population. This examines the factors that influence fertility including age of marriage, contraceptive methods, and patterns of infant feeding, and the effect this has on morbidity and mortality and consequently family and population size in Anglo-Saxon and medieval England.

The issues that affect the osteoarchaeologists ability to analyse and interpret skeletal remains are discussed in the following two chapters. Chapter 7 reviews the funerary practices observed for children within Anglo-Saxon and medieval contexts and discusses the factors that could cause the osteoarchaeological samples to be under-representative of the population, paying particular attention to the differential skeletal preservation, archaeological recovery and cultural deposition of juvenile remains. Chapter 8 examines some of the complications of palaeopathological analysis and the problems of differential and paradoxical diagnoses from skeletal lesions. This chapter also describes the pathological lesions that could imply prolonged periods of stress which may be indicative of the neglect of subadults.

The methods used to conduct this osteoarchaeological research and the chosen Anglo-Saxon and medieval burial populations are identified in Chapter 9. This includes an extensive review of the various different techniques that could be used to estimate the age-at-death and determine the sex of subadult skeletal remains, and contains the results of reliability tests which are conducted on the proposed sex assessment methods to refine the chosen methodology. An explanation is then given for the Mortality Rate Ratio, the method that will be used to standardise the demographic data from the differently sized archaeological populations. The results of the osteoarchaeological and palaeopathological analysis are then provided in Chapter 10. This compares the mortality profiles (age-at-death and sex distribution) and the Mortality Rate Ratios and analyses the occurrence of stress and disease from the subadults Anglo-Saxon and medieval populations. The findings of this research are collated and discussed in Chapter 11, with the significance of the osteoarchaeological results considered with reference to the social values revealed within the documentary evidence analysed throughout this thesis.

Chapter 2

The Practice of Infanticide within Human Society

Introduction

It is important for the archaeologist, when studying past cultures, to realise that the whole procedure of inferring attitudes from the archaeological record is problematic, especially as we are often only provided with a limited view of the practices that occurred within a society. Many assumptions about infanticide made by archaeologists have, unfortunately, been predicted on historically specific and socially constructed belief systems (Scott 2001a: 143). In order to fully examine the question of whether infanticide was practiced in Anglo-Saxon and medieval England, it is necessary to examine where our perceptions of the practice have been obtained. Much of the previous examinations have possibly been influenced by the motives of other societies, including those more recently practicing infanticide. Consequently, it is necessary to first examine infanticide in general, to investigate the situations in which it has been practiced across the world, and to explore the motives and reasoning of those practicing societies.

Infanticide is often described as the killing of unwanted babies, within the first twelve months, but usually at or soon after birth (Mays 1993: 883; Schwartz & Isser 2001: 204). The practice of infanticide is one that present-day westerners regard as cruel and inhumane, to be found only among such peoples who are far removed in both culture and geographical distance from our own society and that of our civilised ancestors (Williamson 1978: 61). Most people in modern western society regard infanticide as just as seriously wrong, if other things are equal, as the killing of an adult person (Kohl 1974: 27; McMahan 2002: 339). Certainly the killing of babies in some contexts seems to us even more fiendishly evil and repulsive than the killing of adults, due their innate innocence (Benn 1973: 101; Hursthouse 1995: 122).

It is because infanticide is considered an abhorrent practice in our own society that researchers failed to realise how widespread its practice is in both the natural world and in human antiquity (Boswell 1989: 41; DeMause 1974: 25; Hausfater & Hrdy 1984: xiii). However, it is now acknowledged by many researchers that infanticide is an old and almost universal custom that has been practiced on every continent and by people on every level of cultural complexity (Cowlishaw 1978: 262; Kellum 1974: 367; Lillehammer 1989: 100; Wilson 1988: 762). Indeed, even in modern England and Wales, children less than one year of age are most at risk of homicide (82 offences per million), compared to the overall risk of fifteen per million in the total population (Lewis 2007: 15).

The following chapter examines the practice of infanticide and its function in human society. This begins with an analysis of the many different motives given for the act of infanticide in practicing societies, including population control, birth spacing, multiple births, illegitimacy, and deformity and regulation of the sex ratio. The different forms of abnormal subadult death are discussed, looking at the direct murder of infants, the indirect cultural practices that may increase the mortality rate of children and the deliberate emotional and physical neglect of children. The effect that such acts have on the relationship between parents and children is then examined, showing how even in societies that practice infanticide, there is strong parental attachment towards those surviving children who have been accepted within the social group. This leads to a review of the philosophical literature regarding infanticide, analysing both the arguments in favour and against the practice, concentrating on the deliberation of whether the neonate holds the status of a conscious human being.

The chapter will then explore the history of infanticide in England, proceeding with a review of the Anglo-Saxon and medieval legislative, ecclesiastical and hagiographical accounts concerning the murder of children, and examining the consequences for the perpetrators. This is followed by a discussion on the possibility that deliberate infanticide cases may have been concealed by the high incidence of juvenile mortality, examining the role of parental negligence in many of the accidental deaths of children in the Anglo-Saxon and medieval texts. The development of English legislation against infanticide is then reviewed, looking at the 1624 Infanticide Act and the effect it had in strengthening the association between illegitimacy and guilt. The consequences of this legislation are discussed, analysing the prosecution and conviction rates for infanticide throughout the seventeenth century, and the response of eighteenth century philanthropists. The chapter then examines how, despite a spate of new legislation introduced during the early nineteenth century, infanticide was still easily concealed before the registration of births and infant deaths had been established in 1874. Finally, we look at the current legal definition of infanticide in England.

Motives for the Practice of Infanticide in Human Societies

A custom that is so widely distributed, both geographically and historically, must have practical functions that explain its persistence through time (Kluge 1975: 182; Williamson 1978: 61). However, just as the occurrence of infanticide has varied over time and across cultures, so have the stated and inferred reasons for the practice

(Scott 2001a: 143; Scrimshaw 1984: 440). No single factor can explain infanticide in all societies: it serves in many different functions, several of which may operate in one society (Williamson 1978: 64). Circumstances whereby infanticide was practiced include children born in too close succession to an older sibling, too large family size, motherless infants, multiple births, illegitimacy, and deformity (Dickemann 1984: 436; Hausfater & Hrdy 1984: xix; Oliverio 1994: 117; Shenk *et al.* 2010: 67; Tooley 1983: 315). Also, poor ecological conditions or economic patterns that give one sex lower breeding or resource accrual potential than the other, that may necessitate the regulation of sex ratios and thus the preferential infanticide of one of the sexes (Dickemann 1975: 129; Hardy & Makuch 2006: 272; Hursthouse 1995: 122; Schutkowski 2006: 222).

Infanticide can play an important role in shaping reproductive biology and social behaviour (Hausfater & Hrdy 1984: xiv; Schutkowski 2006: 222). The control of population as an adjustment to the environmental and economic resources of both the family and the society appears to be the most prominent function (Scrimshaw 1984: 448; Williamson 1978: 61). The response of a population whose nutrient requirements exceed the carrying capacity of its territory, due either to population growth or to resource failure, will be an attempt to recreate an equilibrium by either increasing the available resources, or decreasing the nutrient requirements through population controls such as infanticide (Blaffer Hrdy 1992: 412; Croll 2000: 15; Kluge 1978: 42; Wing & Brown 1979: 170). In such circumstances the killing of a newborn is often explained as a caring act used to improve the chances for survival of either the mother, her older offspring, or for the greater net reproductive fitness of the mother or father of the infant (Alexander 1974: 368; Dickemann 1984: 436; Ginsburg & Rapp 1991: 326;

Levine & Scrimshaw 1983: 683). For example, the Tikopia, inhabitants of a small pacific island isolated by 700 miles of sea, unwillingly practiced infanticide in proportion to the available food (Dickemann 1975: 123; Douglas 1966: 263; Scrimshaw 1983: 255).

It has been suggested that the majority of hunter-gatherer societies (which have characterised human existence for more than 90% of human history) are known to practice infanticide as a means of birth spacing (Hausfater & Hrdy 1984: xxxiii). The Yanomamo Indians of South America kill infants whose older sibling is not thought ready for weaning, which usually occurs around three years of age (Neel 1970: 816; Scott 2001b: 4). In connection to this can be customs that dictated how many children a family should have, and infanticide has been employed as a means of achieving the desired family size (Dasen 1997: 51; vom Saal 1994: 56). This was almost universally practiced amongst Australian aborigines where a woman might be punished for rearing too many children (Tooley 1983: 315).

The origin of removing multiple births may also be found in the inability of a woman in a nomadic society to care for more than one infant at a time (Williamson 1978: 65). The belief is that the mother cannot successfully nurse both twins, and that if she tried both would die, whereas through infanticide at least one twin has a chance (Chagnon *et al.* 1979: 294; Granzberg 1973: 407). In most cases one of the children will be killed, this usually being either the female, the second born, or the weaker twin (Daly & Wilson 1984: 492; Scrimshaw 1984: 446). Examples in contemporary societies include the Kakwa of central Africa who expose the second born twin or the female twin; the Pojulu of Southern Sudan expose twins for a night and if they survive, keep both of them; the Logoli of Western Kenya do not take care of one of the twins but allow the other to survive (Stewart 2001: 22). Whilst rarer, the killing of both twins is reported for the Aranda of Oceania, Lozi of Africa, and in the eastern Tanzania groups the Kutu, Ngolu and Kwere (Daly & Wilson 1984; Stewart 2001: 22). Gender can also be significant, the Khoikhoi of South Africa rejoice at the birth of male twins, show less joy with the birth of two female twins, and bury alive the female of a mixed pair of twins (Stewart 2001: 22). A society's ideology often reinforces the custom of twin infanticide, for example, the Piaroa of Venezuela believe that twins are conceived through intercourse with an evil spirit (Williamson 1978: 65). More common are beliefs that twins are evidence of the mother's infidelity, as was judged by ancient Athenian husbands (Dasen 1997: 49; Granzberg 1973: 406; Scott 2001a: 148), and in Aboriginal Australian societies where there is speculation that the woman has been impregnated by two men (Cowlishaw 1978: 264).

An illegitimate child does not have a proper place in many societies (Pinchbeck 1954: 310). Therefore, if the mother has no husband, or the husband has rejected her or her child, or if the father is known or suspected to be someone other than the husband, the mother often resorts to abortion or infanticide (Mull & Mull 1987: 119). In patrilineal systems especially, a child without a father has no lineage or clan affiliation and is therefore often treated as an outcast (Williamson 1978: 66). Furthermore, unwed mothers lack paternal support for their infants, but more than this, they may find the child an impediment to future marriage prospects (Daly & Wilson 1984: 493; Pinchbeck 1954: 310).

Both physical and mental deformities are common reasons for infanticide (Chagnon *et al.* 1979: 304; Neel 1970: 816). In many parts of the world such children would have trouble surviving even if attempts were made to keep them alive, and so the choice is often made to rear only children who are strong to begin with (Scrimshaw 1984: 446). Even within medical literature published in the last half century it has been argued that critically ill children should be killed 'for their own good' and that to keep them alive is to commit an injustice on their person (Kluge 1978: 32). It is often considered that the killing of the baby may benefit the family to an extent that is sufficient to outweigh the unpleasantness of the killing (Fábrega 1997: 236; Fletcher 1975: 75; Glover 1977: 164; McMahan 2002: 345).

The Ancient Greeks have often been said to have had a very negative view of disability and that they did not, or would not, rear disabled infants (DeMause 1974: 26; Scott 2001a: 147). One of the more famous references is from a passage in Aristotle's *Politics 'With regard to the choice between abandoning an infant or rearing it let it be lawful that no cripple child be reared'* (Sinclair 1962: 294). However, we know that not all congenitally anomalous babies were killed (Edwards 1996: 87). A Hippocratic writer outlines the cure for clubfoot by simple manipulation and bandaging, suggesting that at least some babies with impaired limbs were treated, not destroyed (Edwards 1996: 87). In ancient Roman society also, the Table IV of the law code known as the Twelve Tables, dating to the middle of the fifth century BC, instructs the *paterfamilias* or head of the family to *'Quickly kill…a dreadfully deformed child'* (Bennett 1923: 345; Dasen 1997: 60; Garland 1995: 17).

In some instances, even if there is no apparent problem with the child, it is condemned because a parent, usually the mother, has an affliction such as mental retardation or epilepsy (Scrimshaw 1984: 446). This was discussed by Plato in his

Republic, who advocates the destruction not only of defective children, but those who are the product of inferior parents or of individuals past the ideal childbearing ages (Tooley 1983: 316). The killing or abandonment of deformed or very ill children at birth was noted in twenty-one of the thirty-five societies identified by Daly and Wilson (1984: 492) to have performed infanticide. In only one of these societies, the Blackfoot of North America, was it suggested that this practice was disapproved by the society-at-large (Daly & Wilson 1984: 492). There are again some cultural beliefs that may encourage the infanticide of deformed infants, for example, in some Aboriginal Australian societies it is sometimes believed that deformed and premature babies are of some other species which has entered a woman by mistake (Cowlishaw 1978: 264).

The decision to kill a baby on the grounds of its sex is intimately bound up with culture-specific constructions of gender, kinship, and economic structures such as dowries and patterns of inheritance (Lepowsky 1987: 77; McKee 1984: 95; Nordborg 1992: 195). Whilst not all pre-modern or 'primitive' cultures practice institutionalised infanticide, the anthropological evidence seems to indicate that, among those that do, female babies are more likely to be eliminated than male babies (Croll 2000: 16; Johansson 1984: 463). Very few cases of preferential male infanticide are known (Williamson 1978: 67). Interestingly, many of the societies studied by ethnographers that deny practicing infanticide show remarkably skewed pre-adolescent sex ratios, usually in favour of males (Williamson 1978: 62). This may be due to cultures employing longer birth intervals after the birth of a son than a daughter, therefore improving the survival rate of boys (Hausfater & Hrdy 1984: xxxiii). Nevertheless, if infant mortality is viewed as a means of population control, it is of course more efficient to eliminate females; a few males could keep a population of females reproducing, but there is a limit to the number of offspring a woman can have during her reproductive span (Chagnon *et al.* 1979: 292; Hassan 1979: 152; Scrimshaw 1984: 454).

Female infanticide is common in societies where a high death rate among men would otherwise create an imbalance in adult sex ratios (Kluge 1975: 274; Scrimshaw 1984: 457). The high adult male death rate may be a result of extensive warfare or hunting (Divale & Harris 1976; Williamson 1978: 67). This is the case in harsh environmental conditions where male strength is important (Scrimshaw 1983: 257). For example, Eskimos strongly prefer male children who are the future hunters and who are the virtually sole provider of food since there are no vegetable foods to collect in the long arctic winters (Balikci 1967: 615; Douglas 1966: 263). Without female infanticide the adult sex ratio would become unbalanced as many of the hunters die young in hunting accidents, and there would be too few hunters to provide for the women and children (Freeman 1971: 1014; Williamson 1978: 67). The result would be starvation and death for adults as well as children (Williamson 1978: 67). Other explanations have been advanced for Eskimo society, for example that female infanticide is the assertion of male dominance within the household (Freeman 1971: 1016). Riches (1974: 358) suggests that an Eskimo household is likely to decide to kill a newborn girl if she was not requested for a kinsman's future spouse, lest, in the future, she becomes a spouse of an unrelated household with whom it was competing for resources.

Female infanticide is also common in patrilineal cultures where males are considered stronger and more valuable than females (Arnold & Kuo 1984: 316; Choe *et* *al.* 1998: 208; Scott 1992: 84; Sofaer Derevenski 1994: 15). Placing a higher value on male work, assigning important rituals to men only, giving most or all the political power to men, and having customs that dictate that men inherit to the detriment or exclusion of female heirs, all encourage the preservation of male infants and the devaluation of female infants (Candib 1999: 191; Dickemann 1984: 429; Johansson 1984: 464; Sudha 1999: 592). Popkin (1980: 424) suggests that there has often been a preference for infanticide over contraception or abortion because infanticide makes possible a conscious control of the sex ratio. This is still seen in modern societies where sex pre-selection, prenatal sex determination and sex-selective abortion have in many counties led to increased abortion rates of female foetuses (Clark 2000: 95; Hardy & Makuch 2006: 272; Jha *et al.* 2006: 211; Judson 1994: 503; Raley & Bianchi 2006: 401; Zhu *et al.* 2009: 1). Sex selective abortion (termed female feticide by some) is thought to be most prevalent in India, China, Taiwan and Korea (Edlund 1999: 1276; Ginsburg & Rapp 1991: 315; Oomman & Ganatra 2002: 184; Sudha 1999: 586; Zhu *et al.* 2009: 1). In India, the practice of sex selective abortion became so prevalent that the government felt obliged to introduce the Prenatal Diagnostic Technique (Regulation and Prevention of Misuse) Act in 1994 which made it is illegal to determine and communicate the sex of the foetus (Fathalla 2000: 8; Sudha 1999: 597). However, this has not stopped the illegal ultrasound sex tests which are still often advertised with catchphrases such as ‘spend 600 rupees now and save 50,000 rupees later’ (Blakely 2009). A careful demographic analysis of the sex ratios in different populations led to the conclusion that no less than 60 million and probably up to approximately 100 million females are missing in the world (Fathalla 2000: 9).

Sons are often wanted to continue the family name and for a variety of economic reasons including old age support for their parents (Dickemann 1975: 126; Miller 1987: 100; Oomman & Ganatra 2002: 184). For example, in Imperial China females were not valued and were selected for infanticide because males were preferred to perpetuate the family line (Hingorani & Shroff 1995: 169; Scott 2001b: 7; Scott 1999: 72). Female infanticide in late-nineteenth-century China reached high proportions and sometimes as many as a quarter of the marriageable men in the peasant class could not find a wife (Dickemann 1979b: 341; Williamson 1978: 69). The decreased proportion of recorded female births, the persistently high ratios of males to females at ages under sixty, and evidence from a variety of observers suggest that female infanticide in China, directly or indirectly through decreased care, has not disappeared (Candib 1999: 191; Koenen & Thompson 2008: 63).

Dowry systems and other mechanisms operating to transmit the woman's wealth to the family into which she marries are often causes for male preference and the subsequent infanticide of females (Choe *et al.* 1998: 208; Fuse & Crenshaw 2006: 363; Hingorani & Shroff 1995: 169; Miller 1987: 100). In societies where the preferential marriage form is hypergamy, with women marrying men of higher castes or classes, preferential female infanticide occurs because large dowries are needed for female offspring (Scrimshaw 1983: 257; Williamson 1978: 68). An extreme case of preferential female infanticide as a by-product of hypergamy was found among the high caste Jhareja Rajputs of northwestern India (Dickemann 1979b: 328; Oomman & Ganatra 2002: 184). The practice in North India was positively correlated with social status, and reaching such extremes that in the upper classes of highest ranking castes all or almost all daughters were destroyed at birth (Dickemann 1979a: 164; Langer 1974b: 133;

Pakrasi 1970). Therefore, when the cost of rearing daughters is high, either due to lower prestige, the need to accumulate a dowry, or time lost suckling a daughter when it could be spent getting pregnant with a more desirable male child, parents are less likely to keep a female child (Balikci 1967: 621; Freeman 1971: 1014; Scrimshaw 1984: 447; Sudha 1999: 592).

There are, however, some daughter preferring societies where the females are valued for their social and economic capacities (Scott 1999: 72; Scrimshaw 1983: 257). In some of these societies, preferential male infanticide, rather than female, is practiced: including the Iscobakebu of Peru, Mundugumor of New Guinea, Tiwi of North Australia, and the Warao of Venezuela (Scrimshaw 1983: 257; Williamson 1976: 111). However, male infanticide has also been practiced in societies where men hold the greater economic status, although this is usually in times of economic hardship. For example, the Rendille, camel herders in the Kenyan Highlands, limit the numbers of male camel owners because the herds upon which they depend increase only slowly due to the harsh environment (Douglas 1966: 263; Mays 2000: 183). Recently it was reported that in the attempt to stop the tribal fighting that had occurred in the region since 1986 the women from the villages of Agibu and Amosa in the Gimi region of Eastern Highlands province, Papua New Guinea, had agreed to smother all new born sons (Shears 2008). Scott (2001a: 144) also argues that, within archaeological contexts, it is possible to present a substantial amount of evidence for the practice of preferential male infanticide that is of as good (or even better) quality than the supposed evidence for female infanticide. For example, the Bronze Age cemetery at Mokrin in Serbia, Roman Ashkelon in modern Israel, and the Phoenician city of Carthage in North Africa, all provide potential contexts for male infanticide (Scott

2001a: 144). In modern Europe, boys are at increased risk compared to girls, especially those aged between one day and six months, which may be a consequence of parental attributions about the infant's behaviour, as male infants are perceived as more aggressive and requiring harsher discipline than female children (Liem & Koenraadt 2008: 172).

Murder and Neglect of Children

Whether or not infanticide is sanctioned by a particular society, such practices are rarely recorded (Hausfater & Hrdy 1984: xxvi) and very difficult to detect (Williamson 1978: 62). Therefore, accurate data on actual frequencies of infanticide are virtually non-existent (Scrimshaw 1984: 447). This is because, even within cultures that openly practice infanticide, the act is usually performed quietly by the mother or other close relative with no further discussion on the matter (Blaffer Hrdy 1992: 412; Levine & Scrimshaw 1983: 683). If the death is reported at all, it is listed in the category of stillbirth or accident, and as such it is unlikely to be recognised as infanticide (Daly & Wilson 1984: 489; Williamson 1978: 62).

In modern cases the killing of newborn babies within 24 hours of birth usually committed by somewhat passive and immature young single mothers (Marks 1996: 99; McDermaid & Winkler 1955: 32; Wilczynski 1995: 367). Contrary to medico-legal tradition, puerperal psychotic illness is a relatively rare cause of maternal neonatalcide (Koenen & Thompson 2008: 67; Lambie 2001: 72; Marks & Kumar 1993: 338). Most studies have shown that neonaticidal women are younger and are far less likely to be married than those who murder older children (Koenen & Thompson 2008: 67). They usually face their pregnancies alone, rarely pursuing any type of prenatal care, most deliver their child in secret and less than 5% give birth in a hospital (Koenen & Thompson 2008: 67). The motivation to kill is usually because the child was unwanted and the infant's death is more likely to have resulted from inaction rather than the violent action which often characterizes the killing of older infants (Marks 2006: 13). The over-representation of young women in studies of neonaticide may be in part a consequence of their naivety; it is likely that more mature, worldly women are better able to successfully conceal an unwanted pregnancy and dispose of the newly delivered infant in such a way that it remains undiscovered (Marks 2006: 13). Fathers almost never commit neonaticide and are responsible for only 5% of infanticides involving victims less than one-week-old; however, fathers are the most frequent perpetrators of filicide in later childhood (Koenen & Thompson 2008: 69).

Most methods of infanticide do not leave forensically detectable traces of violence (Scott 1999: 66; Wileman 2005: 89). The most common method of infanticide appears to be suffocation (Scrimshaw 1984: 442) for example, smothering is reported for the !Kung of southern Africa, the Tikopia, and some Atlantic Eskimo groups (Balikci 1967: 619; Williamson 1978: 64). Furthermore, if a mother dies in childbirth, or shortly thereafter, in a society where the alternatives to breast milk are not a viable option, her infant is frequently buried with her to reduce its suffering, as in parts of Africa and New Guinea (Blaffer Hrdy 1992: 436; Williamson 1978: 65). Drowning was also a cause of suffocation such as in India and China where the baby would be drowned in a jar of milk (Langer 1974b: 133; Scrimshaw 1984: 442). Employing a weapon or a toxic substance are less common methods (Kellett 1992: 16; Williamson 1978: 64). Reports from India, however, indicate that sometimes the mother would smear opium or another poison on her nipples, which produced quick painless results (Langer 1974b: 133; Scrimshaw 1984: 442).

Exposure is also a widely practiced although it does not actually take the child's life, and, depending on the location, may provide the parents' hope that there is some possibility that others will adopt and care for it (McKee 1984: 99; Williamson 1978: 64). For example, the Eskimo groups of the Arctic coast of Northern America placed the unwanted newborn infant in the snow porch where its cries could be heard by all visitors (Balikci 1967: 619). In Ancient Rome the right of the father to expose a new-born baby, particularly if he suspected its paternity, remained the strongest aspect of his 'right of life and death' (*ius vitae necisque*) over his children (Adkins & Adkins 1994: 340; Allason-Jones 2004: 273; Corbier 1991: 135; McNamara 1987: 108; Radin 1925: 338). However, killing children is not only morally different from leaving them in a place where they might be picked up and reared; it also entails dramatically different demographic consequences (Boswell 1989: 45). If even a small percentage of abandoned children were rescued, exposure would have a less dramatic effect on the next generation than an equal rate of infanticide (Boswell 1989: 45).

There are also a variety of customary practices found cross-culturally that operate indirectly, and do not result in immediate destruction, but can reduce the probability that a weaker child will survive (Hausfater & Hrdy 1984: xxix; Molleson 1989: 30). For example, a medico-demographic survey conducted by Dr Retel-Laurentin of the Bobo-Oulé of Upper Volta in 1971 indicated that the high prevalence of neonatal death caused by tetanus at the end of the first week of life was attributable to the custom of rubbing the umbilical cord with soil (Retal-Laurentin & Benoit 1976: 282). In the midtwentieth century the Temne of Sierra Leone were advised by local health authorities to discontinue the traditional method used to ‘toughen’ children, these involved bathing infants in the cold waters of a running stream at dawn and swinging them dry in the cold morning air, to reduce the high percentage of infant fatalities from pneumonia (McKee 1984: 98). Molleson (1991: 120) also proposes that children who survived such hazards surrounding their birth would have been better able to withstand later stresses and infections than less rigorously selected infants.

Other authors discuss passive infanticide, which is defined by Scrimshaw (1984: 441) as “any combination of medical, nutritional, physical or emotional neglect of an infant or young child in comparison to other children in the family or to children of families in similar socio-economic and educational circumstances”. Technically infanticide refers to the deliberate elimination of human infants under one year of age, but the specific forces that lead adults to devalue, particularly female, newborns are diverse and do not necessarily cease to operate once the first year of life has passed (Johansson 1984: 463). This method is also sometimes described as ‘deferred infanticide’ (Fathalla 2000: 130; Fuller *et al.* 2006b: 51). Neglect reduces a small child in a short time to an unresponsive, totally passive creature who soon appears subhuman, almost vegetable like (Piers 1978: 17), death soon occurs from malnutrition and infectious disease (Steele 1978: 84). Although passive infanticide tends to occur after some time has elapsed, it is most common within the first two years of life (Scrimshaw 1984: 449). Data from modern Bangladesh shows that girls have twice the risk of dying from malnutrition and diarrheal diseases as boys between ages one and four; they were less likely to be taken to the hospital for these conditions and less likely to survive (Candib 1999: 192).

The Parent-Child Relationship

It is often argued that the more persistently that a population has suffered from Malthusian checks; wars, hunger, epidemics, the more fatalistic the predominant attitudes toward life will be and the more indifferent parents will become toward each of their offspring (Scott 1992: 87; Tucker 1977: 19; Voland 1998: 361). Furthermore, it has been suggested that acceptance of infanticide will lead to a weakening of parental feeling, even cruelty towards children (Lyman 1974: 91; Scheper-Hughes 1987: 14; Tooley 1983: 413). Nonetheless, anthropological studies indicate that the practice tends, if anything, to be associated with a strong sentimental attachment and protectiveness towards children with a serious view of the parental role (Benn 1973: 102; Mays 1995: 8). Where parents themselves are implicated in the elimination of offspring, it is often because continued demands by the offspring on scarce resources are anticipated (Hausfater & Hrdy 1984: xv; Williamson 1978: 64). The social, moral and economic values of the infant and small child may be measured against those of older children, adults and the family unit as a whole (Blaffer Hrdy 1992: 412; Scheper-Hughes 1987: 2). The parents, especially the mother, are likely to be greatly distressed by the killing of their baby (Glover 1977: 163). Parental elimination of unwanted infants tends to be carried out with a minimum of violence; rarely are wounds afflicted (Scrimshaw 1984: 448; Williamson 1978: 64). Psychologists say that such mothers apparently feel compelled to keep the dead babies near at hand, despite their shame at what they have done (Boyes 2008). Because the meanings of different kinds of death, the meaning of childhood, and the nature of the parent-child relationship vary enormously among societies, so will responses to child death (Tarlow 2000: 741). Therefore, exposure, infanticide and frequent infant death must not be confused with parental indifference (Lee 1994: 70; Mays 1995: 8; McKee 1984: 99; Schutkowski 2006: 224).

It is, however, common in many societies for the practice of infanticide to be made culturally and personally acceptable by a definition of life that requires a ‘waiting’ period after birth where the child is not considered fully human until accepted as a member of the social group (Barley 1995: 179; Scrimshaw 1978: 393; Tooley 1983: 311; Ucko 1969: 270). This acceptance may take place when the child is named, when it appears strong enough to survive, or when it shows ‘human’ characteristics, such as walking and talking (Scott 1992: 87; Williamson 1978: 64). Therefore, in most societies where infanticide occurs, the event takes place very early in life before the infant or very young child has the status of a real person in the society (Austin 2007: 7; Cowlishaw 1978: 268; Scrimshaw 1984: 440). Among Andean Indian groups, a child may not be acknowledged as a permanent family member until it has survived its first year (Oliverio 1994: 106). The Peruvian Amahuaca do not consider children fully human until they are three years old (Oliverio 1994: 106). Emotional distancing from newborn infants can, in harsh circumstances, be a necessary self protective mechanism both for societies and for individuals within those societies (Hoyles 1979: 21; McMahan 2002: 342; Scheper-Hughes 1987: 2).

Philosophical Discussions of Infanticide

Much of the modern-day philosophical debates of infanticide are also concerned with the metaphysical problem of whether persons, however defined, have an absolute or unqualified right to live (Aiken 1973: 177; Fletcher 1978: 18). In particular, whether infants possess the properties required to live (Carter 1997: 9; Fletcher 1975:

75; Montague 1989: 63; Schaffer 1971: 13). Glover (1977: 156) argues that the objection to killing provides no argument against infanticide, for newborn babies have no conception of death and so cannot have any preference for life over death. Tooley (1973: 90) maintains that neonates do not possess concepts, beliefs and desires, and so there is a period in which infanticide is morally permissible. However, Kluge (1978: 36) argues that by the end of the fourth month of the gestation period, certainly by the sixth, the brain of the foetus is structurally and functionally sufficiently developed so as to leave no doubt that the criteria for personhood in the constitutive sense are met. Consequently neonates also normally meet the requirements for personhood: that they are persons and, therefore, to commit infanticide is to commit murder (Kluge 1978: 36; Kluge 1975: 209).

The arguments in favour of infanticide are much more numerous and sophisticated than the arguments against it (Kluge 1975: 190). There is a distinction between the concepts of being a person and a human being (Kluge 1978: 33). A human being is an essentially biological concept denoting membership in the species *Homo sapiens*, its criteria of application are material in nature and involve such parameters as morphology, genealogy or ancestry, genetic make-up and the like (Kluge 1978: 33). Whereas the concept of a person is a moral notion, fraught with ethical overtone (Kluge 1975: 191). To contend that there are cases in which it is good and therefore right, to induce the end of a person's life obviously assigns a value to human life rather than to merely being alive (Aiken 1973: 177; Fletcher 1978: 20; McCormick 1974: 172; McMahan 2002: 345). Since all values are relative to a given society and a given time, we cannot say absolutely that infanticide is morally evil (Kluge 1975: 192). The best we can say is that our society has accorded it a negative status and that according to this particular ethos, infanticide is unacceptable (Benn 1973: 101; Kluge 1975: 192).

Abandonment and Infanticide in Anglo-Saxon and Medieval England

That infants were at the least abandoned during the Anglo-Saxon period is suggested by the Ine of Wessex (688-694) Law 26; *'For the maintenance of foundling 6 shillings shall be given in the first year, 12 shillings in the second, 30 shillings in the third, and afterwards according to his appearance'* (Attenborough 1922: 37). Foundlings were also a social issue within the medieval period; between 1195 and 1295 at least thirteen different councils in England passed legislation directly or indirectly bearing on the abandonment of children, although these were more concerned with the dilemma of whether or not to baptise abandoned children found without any indication of their baptismal status (Boswell 1989: 322). In the *Liber poenitentialis* (1208–1213) Robert of Flamborough warned *"if by your authority or with your counsel or aid any infant was abandoned and then died of hunger or mishap or was not found, in my opinion you should not be ordained"* (Boswell 1989: 334). In 1448 Joan Meller and her husband were convicted in the Province of Canterbury of having left their child exposed, in consequence of which the child perished (Helmholtz 1975: 380).

The *Lives of the Saints* provide several examples of attempted infanticide from across Europe; the mother of St. Germain of Paris (576 AD) wanted to abort him because he was conceived too soon after the birth of another child (Boswell 1989: 210; Herlihy 1985: 53; McLaren 1990: 124). The father of St. Odilia (c. 662-720 AD) determines to kill her, because she is born blind (Herlihy 1985: 53; McLaren 1990:

127). The life of the Bishop St. Ludger (742-809 AD) tells us how the birth of his mother so enraged her pagan grandmother that she sent servants to kill the child before she could take milk from her mother's breast; *"because it was the custom of the pagans, that if they wished to kill son or daughter, they would be killed before they had been given any food"* (Boswell 1989: 211; Herlihy 1985: 53). According to Paul the Deacon (c. 720-799 AD), Lamissio (a future king of the Lombards) and his siblings had been tossed in a fish pond to die by their prostitute mother, before being rescued by King Agelmund (Boswell 1989: 210). St. Bathild (c. 626-680 AD) is reported to have told her husband, King Clodovic, *"that the most evil and impious institution ought to be ended, according to which many men seek to kill their offspring and not to rear them"* (Herlihy 1985: 53). In the study of miracles of five English Saints, Gordon (1986: 517) identified two cases of infanticidal mothers; one woman dismembered one of her newborn twins while afflicted with a postpartum psychosis, another insane woman nearly strangled her child before bystanders rescued it.

There are some examples of infanticide to be found within other documentary sources including a letter written around 746 by St Boniface and seven other missionary bishops to King Æthelbald of Mercia admonishing him for the unchasity of his people (Boswell 1989: 210; Mays 2000: 185; Morton 1992: 52); *"…when those harlots, whether nuns or laywomen, bring forth in sin offspring conceived in evil, they for the most part kill them; not filling the churches of Christ with adopted sons, but crowding graves with bodies and hell with unhappy souls…"* (Whitelock 1979: 816-822). In his tenth-century homilies, Ælfric was clear that infanticide was among the list of sinful activities of the population: *"Some of them [women] kill their children before they are born, or after birth, that they may not be discovered, nor their wicked adultery* *be betrayed"* (Crawford 1999: 67). The twelfth-century Law of Henry the First 70,15: *'If an infant slays or is slain, whether he has been given a name or not, the full wergild shall be contributed'* (Downer 1972: 223), indicates the killing of another's child was made punishable in the same way as adult homicide (Damme 1978: 8; McLaughlin 1974: 121).

The teachings of Christianity included the prohibition of infanticide, which goes against the Christian doctrine of the soul (Lyman 1974: 90; Russell 1937: 507; Sauer 1978: 82; Williams 1978: 117). Its prohibition appears as early as the beginning of the second century in the Epistle of Barnabas; *'never do away with an unborn child, or destroy it after its birth'* (Donaldson 1907: 188; Nelson 1994: 92; Stager 1991: 42; Staniforth 1968: 217; Wilson 1988: 763). That these practices had continued after the conversion of Constantine (c. 312 AD) is testified both by the necessity for continuous additional legislation and also by the repeated condemnation of infanticide by church figures and synodal meetings (Giladi 1990: 185; Langer 1974a: 355; Lyman 1974: 90).

The penalty for infanticide was accordingly strict at least as recorded in some of the early penitentials (Mays 2000: 185). Theodore of Tarsus (Archbishop of Canterbury 668-90) equated child murder with homicide and prescribed a fifteen year penance; but, significantly, he also stipulated that if a woman who slew her own child was poor, the penance should be reduced to seven years (Crawford 1999: 94; Kellum 1974: 369). Likewise, in an eighth-century penitential attributed to Bede, the penance was to be that of a murderess: *'but it makes a great difference whether a poor woman does it on account of the difficulty of supporting the child or a harlot for the sake of concealing her wickedness'* (McNeil & Gamer 1938: translated by Kellum 1974: 369). The penances in the eighth-century Frisian text *Paenitentiale Oxoniense II* by Northumbrian missionary St Willibrord differentiate depending on the mother's situation, and in the case of captive mothers whether she had accepted the child (considered the point of first feeding), as well the motive for infanticide of which infidelity required the harshest penance (Meens 1994: 57). Burchard of Worms, in the early eleventh century, considered it a great difference whether the guilty person is a *'poor little woman'* and acted on account of the difficulty of feeding or whether she acted to conceal a crime of fornification; in the former case the punishment of ten years penance was apparently halved (McLaughlin 1974: 157).

The medieval English synodal legislation reflects a significantly sustained effort not only to punish the delinquent but to admonish and instruct ignorant, negligent and ill-intentioned parents (Daniell 1997: 126; McLaughlin 1974: 121). However, until the sixteenth century the law did not clearly state that a mother was culpable of murder when she killed her infant (Gordon 1991: 154; Hanawalt 1986: 102; Jackson 1996: 30; Langer 1974a: 356; McLaren 1990: 127). Jurors were thus unsure about whether indictments could be brought or not and, if they were, what was to be done with the woman who proved to be guilty of killing her newborn child (Hanawalt 1986: 102). This is reflected in a sample of about 4,000 homicide cases taken from coroners' rolls and jail delivery rolls (AD 1265-1413) where there were only two cases of newborn infants being murdered (Hanawalt 1986: 102; Hanawalt 1977: 9; Kellum 1974: 371). In one case Alice Grut and Alice Grym were indicted for drowning a three-day-old baby in a river, they were both acquitted (Hanawalt 1976a: 307; 1976b: 130). In the other case, the jurors of Oxford said that a baby girl, one-half-day old, was carried downstream, and they knew nothing about the father or the mother (Hanawalt 1976a: 307).

As the quantity of surviving documentation increases from the fifteenth century, we are presented with further cases of infanticide. Helmholtz's (1975) study of fifteenth-century court records of the Province of Canterbury (which covered all of southern England and Wales) identified thirteen prosecutions for infanticide between 1447 and 1455 from the Rochester records and ten prosecutions recorded in the diocesan court at Canterbury between 1469 and 1474 (Helmholtz 1975: 379). Most of the infanticide prosecutions involved the parents of the child, with more women than men accused of committing infanticide, although it was by no means an exclusively female crime (Helmholtz 1975: 385). For example, the records from the Consistory Court of Rochester (1447) report that Thomas Patrick *'admitted killing his child by holding it under water until it drowned'* (Helmholtz 1975: 380). The largest number of prosecutions for infanticide found in any one year was the four reported at the Commissary court of the bishop of London in 1487, although one a year is more usual for most of the courts surveyed, and in some years none at all (Helmholtz 1975: 384). However, Helmholtz (1975: 382) stresses that not all those who were accused of infanticide admitted the crime; in cases of denial, compurgation was required whereby the accused took a solemn oath of innocence before the court supported by the oaths of a specified number of neighbours (Helmholtz 1975: 382). If the accused admitted the charge of infanticide, or denied it but failed in the assigned canonical purgation, the Church court assigned a humiliating public penance (Damme 1978: 6; Helmholtz 1975: 383). For example Joan Rose convicted at Canterbury in 1470 of killing her son was ordered to dress in penitential garb and *'go before the procession in the parish church of Hythe on three Sundays with a wax candle of half a pound in her right hand and the knife with which she killed the boy, or a similar knife, in her left'* (Helmholtz

1975: 383). The most severe penance reported within the Province of Canterbury called for public penance lasting over a seven year period, but this occurred in the case of drowning a boy who was almost seven-years-old (Helmholtz 1975: 384). The penance was not, however, equivalent to secular punishment for homicide and the evidence suggests that no independent secular prosecution was undertaken (Helmholtz 1975: 383). This is reflected in a study by Adair (1996: 44) of parish registers from 250 parishes of the sixteenth and seventeenth centuries, where only four cases of infanticide are noted.

Parental Negligence and Infant Mortality in Anglo-Saxon and Medieval England

The extraordinarily low incidence of recorded infanticide and child murder does not necessarily mean that it was rare (Hammer 1978: 13; Hanawalt 1977: 9). High infant mortality rates could have made infant deaths easy to conceal, possibly through reporting them as accidental deaths (Hanawalt 1977: 10; Hoffer & Hull 1981: 6; vom Saal 1994: 50). In particular, there is the testimony of the law codes and the penitentials to attempts to prevent the 'overlaying' of infants (Finucane 1977: 109; Kellum 1974: 375; Shahar 1990: 139). Overlaying is the term used to describe the suffocation of infants whilst sleeping in beds with adults (Kellett 1992: 2; McKenna *et al.* 2007: 139; McLaren 1990: 127), through stifling under the weight of an adult body, or being inadvertently smothered by the bed cover (Meens 1994: 58; Shahar 1990: 129). Overlaying, of course, could be accidental (Damme 1978: 3; Langer 1972: 96; Sauer 1978: 81), furthermore it has been suggested that many of the deaths were possibly caused by the respiratory viruses that are today often implicated in the so-called Sudden Infant Death Syndrome (Scheper-Hughes 1987: 6; vom Saal 1994: 50).

From the penitentials of Adamnan and Columban in the sixth and seventh centuries to the *Corrector* of Burchard of Worms in the eleventh century, churchmen as well as authors of medical works cautioned against the practice of taking infants into the beds of adults (Damme 1978: 4; Duby 1998: 13; McLaughlin 1974: 120; Meens 1994: 56). For example, the Frankish Penitential of St. Hubert (ca. 850) declared *'if anyone overlays an unbaptised infant, she shall do penance, for three years. If unintentionally, two years'* (McNeill & Gamer 1938: 293 translated by McLaughlin 1974: 156). One tenth-century homily of Ælfric warned against the foolish women who share their beds with their children but roll over on them and suffocate them, and the woman who breastfeeds her child and then falls asleep and smothers the child with her own breasts (Crawford 1999: 94). Gordon (1991: 154) indicates five cases within the hagiographical literature (the posthumous miracles of saints from the twelfth through to the sixteenth century) where suffocation nearly claimed the lives of babies who were sleeping in beds with adults, all of which were reported in the Cantilupe miracles. In a hagiographic story provided by Finucane (1977: 109) we are told of a grandmother who, when discovering her daughter had fallen asleep whilst feeding her infant, screamed *"Get up, get up daughter. Look: you have crushed your child"*.

The cautions against overlaying and general parental negligence are still repeated in the twelfth and thirteenth centuries (Damme 1978: 3; McLaren 1990: 127). In the early twelve-century Law of Henry I 88, 7: *'If anyone kills or while sleeping crushes another person's child who has been entrusted to him for rearing or instruction, he shall pay compensation for him just as if he had killed an adult person'* (Downer 1972: 271). In the thirteenth-century Councils, II, 1,10 (Salisbury I, 1217): *'women are to be warned to nurse their children carefully and not to take them into bed with them at night lest they* *overlay them'* (McLaughlin 1974: 157). Also the *Statutes of Winchester I* in 1224 state that *'Under threat of excommunication from the church, women should be restrained from keeping their children close by in bed lest they smother them while in sleep'* (Damme 1978: 3; Powicke & Cheney 1964: 136). Again in the *Constitutiones Cuiusdam Episcopi* of 1225 x 1230: *'Woman again are to be admonished to take care that they do not hold their children close by in the night lest they be smothered'* (Damme 1978: 4; Powicke & Cheney 1964: 183). Once more in the *Statutes of Coventry* issued between 1224 and 1237: *'Likewise, it is to be known that no woman lay down her child in bed with her unless it is or is about three years of age'* (Damme 1978: 4; Powicke & Cheney 1964: 214).

Despite the many warnings of overlaying, the secular court records before the fifteenth century list no trials for the crime of causing the death of an infant through sharing a bed (Gordon 1991: 154; Hanawalt 1986: 102; Shahar 1990: 129). A rare fifteenth-century example found in the Act Books from the Province of Canterbury is provided by Helmholtz (1975: 381): In 1454 Stephen Tiler and his wife Joan were cited before the Rochester court for having *'smothered their daughter [who was] lying between them in bed'* and in 1472 Alice Michel of Hythe was accused of having *'lain on top of her boy in bed until he was dead'*. Perhaps because as, for example in the late fourteenth-century handbook of *Instructions for Parish Priests* (Myrc 1902), overlaying was treated as simply another item on a list of venial (pardonable) sins (Gordon 1991: 154; Kellum 1974: 368). This is unsurprising as it would have been virtually impossible to establish whether the death of an infant by overlaying was accidental or deliberate (Damme 1978: 3; Kellum 1974: 375; Langer 1972: 96; Sauer 1978: 81).

Only one case of overlaying appeared among the accidental deaths of infants listed in the Coroners' Rolls and Jail Delivery Rolls (AD 1265-1413) studied by Hanawalt (1986: 178); *'Robert, son of John Brown, was in the care of Isolda (possibly a wet nurse) who took Robert to bed with her and around 11 o'clock at night rolled over and crushed him'*. However, 50% of the cases involving children one year and under were caused by fire and 21% by drowning (Hanawalt 1977: 10). Swaddling and tying infants in cradles may have prevented some accidents, but cradle fires were the leading cause of accidental death among infants (Finucane 1977: 109; Gordon 1991: 158; Hanawalt 1986: 175). A typical case described in the coroners' rolls showed a child lying in its cradle next to the hearth when a chicken or pig came in and knocked burning straw or an ember into the cradle (Hanawalt 1986: 177; Hanawalt 1977: 15). Councils, II, 1,214 (Coventry, 1224) refers to the dangers of drunkenness especially the setting of fires in which the guilty are suffocated with their children (McLaughlin 1974: 157).

The only death of a child a year or younger examined in the Coroner's Rolls (AD 1265-1413) was that of six-month-old Joan Ross who was scalded to death when a pot of boiling water which was precariously balanced on the hearth fell on her (Kellum 1974: 371). The incident was treated as an accident, as of course it could have been; but the case does bear close resemblance to the warnings in the seventh century by Theodore of Tarsus (Crawford 1999: 94) which is repeated in the twelfth-century penitential of Bartholomew of Exeter; *'if a woman place an infant by the hearth, and a man put water in the cauldron, and it boil over so that the child is scalded to death, the woman must do penance for her negligence but the man be acquitted of blame'* (Hanawalt 1986: 178; Kellum 1974: 371). In the early eleventh-century penitential of Burchard of Worms, a penance of three years is imposed on a woman who has placed her child near a fire, so that the child was killed by boiling water from a kettle that was hung there by someone else (Meens 1994: 61; Shahar 1990: 116). It is not the person who boiled the water who is to blame, Burchard says, but the mother who has put her child in such a dangerous place (Meens 1994: 61).

The extent of the burns experienced by some of the children seems to indicate that infants were often left alone in the house, and a few cases tell us this directly (Hanawalt 1986: 177; Hanawalt 1977: 15). In one inquest from the Coroners' Rolls and Jail Delivery Rolls (AD 1265-1413) studied by Hanawalt (1977: 15) the jurors said that the father was in the fields and the mother had gone out to the well when the child was burned. Parental negligence is observed from another case where the cradle of a one-year-old girl was overturned into the fire by the two small pigs roaming within the house (Hanawalt 1986: 177). In the study of the Miracles of Six English Saints by Gordon (1991: 156), parental carelessness led to a near-tragedy when a fifteen-month-old baby, left alone at home while his parents went to vespers at a nearby church, fell backwards onto the hearth with his head in the coals. Cases like these indicate why the Church felt it necessary to warn women not to leave their children *'alone in the house where there is a fire or near water without someone watching them and this should be said to them every Sunday'* Councils, II, 1,10 (Salisbury I, 1217) (McLaughlin 1974: 157).

Drowning in wells and especially ditches was a common type of infant-child death listed in the Coroners' Rolls and Jail Delivery Rolls (Finucane 1977: 109; Kellum 1974: 371). Several examples are found within the Rolls of the Justices in Eyre, Yorkshire, (1218-1219): '*Maeta daughter of Walter of Methey was drowned in a ditch'* (Stenton 1937: 185)*, 'Adam of Marr was found drowned'* and '*Hugh son of Norman in the same* *way was found drowned'* (Stenton 1937: 203), '*A two-year-old girl was found drowned in the East ditch (of York)'* (Stenton 1937: 288). In all four of these cases from the Eyre Rolls of Justices the recorded verdict was misadventure with no one suspected of infanticide. However, in a 1470 case from the Canterbury Act Books we appear to have evidence of infanticide where Stephen Colyn threw his illegitimate son into a ditch and the child died, but unfortunately no verdict is recorded (Helmholtz 1975: 380).

Gordon (1991: 152) also noted that wells attracted seventeen toddlers and young children in a study of the accidents reported in the Miracles of Six English Saints from the twelfth to thirteenth centuries. One example is the story of Edith Drake who sent her eighteen-month-old son John out to play in the road with other children while she swept her house; John wandered off and fell into a watering pond (Gordon 1991: 157). Undoubtedly many factors are involved in these cases: little children are sometimes fascinated by water, and parental disregard would have been all that was necessary for an accident to occur (Kellum 1974: 371). The likelihood of such accident would be greatly increased if young children are left either on their own or with an ill-equipped caretaker; for example the thirty-week-old child that was left in the care of a neighbour's three-and-a-half-year-old son, or Maude who was found drowned in a ditch after her mother left her in the care of a blind woman; both cases come from Coroners' Rolls and Jail Delivery Rolls (AD 1265-1413) (Hanawalt 1986: 177).

The Rise of Legislation and Illegitimacy

It is perhaps more than mere coincidence that James 1's statute 'Act to Prevent the Destroying and Murdering of Bastard Children' passed by the Commons on 27th May 1624 named drowning as one of the two most common ways 'lewd mothers' did away with their children (Jackson 1996: 32; Kellum 1974: 371). The need for such legislation is indicated in some of the crimes reported in the Elizabethan Essex rolls studied by Emmison (1970: 157); '*In the house of John Perrye yeoman, her master, at Stanford-le-Hope, [a woman] secretly gave birth at night, after which she cut the baby's throat and threw him into a nearby stream, weighted with stones; guilty'* and also *'One spinster, on 21 October 1570 between 12 and 1 a.m. at the house of William Fytche gentleman, her master, at Little Canfield (Hall), gave birth to a dead infant in the backhouse and threw it into his horse pond; no verdict given'* (Emmison 1970: 157). The 1624 Act was the first specific legislation concerning infanticide. In passing this act, parliament was taking cognizance of the great peril to the lives of illegitimate children to which society had subjected them, and was equating their death with murder (Goody 2000: 80; Scott 1999: 66; Williams 2001: 480). This statute decreed that if an unmarried woman concealed a birth and the child was subsequently found dead, she was presumed to have killed it unless she could prove that the child was born dead (Damme 1978: 13; Jackson 1996: 33; Sauer 1978: 82). No longer burdened by the problems of proving live-birth, the prosecution nevertheless had to establish that the child's death had been concealed (Adair 1996: 44; Goody 2000: 80; Jackson 1996: 33; Kipp 2007: 125; Walker & McCabe 1968: 126). If a woman failed to prove that her child had been still-born, however, she was to 'suffer Death as in Case of Murther' (Jackson 1996: 34; Lambie 2001: 73; Walker & McCabe 1968: 126).

The association between illegitimacy and guilt was strengthened with the introduction of the 1624 statute; not only were the mothers of bastards more frequently accused of murder than the mothers of legitimate children after that date, but they were also more likely to be found guilty (Damme 1978: 12; Jackson 1996: 36).

This is highlighted by the comparison of the case of Sinah Jones a servant-girl who was indicted in the Old Bailey Sessions Papers (1688) *'for murdering her illegitimate son'* and subsequently received the death sentence, with that of a '*married woman of good reputation'* from Aylesbury who was acquitted after killing her legitimate infant despite a lack of motive (Damme 1978: 12). If the child was legitimate and the mother had made no attempt to conceal her pregnancy or its birth it was less easy to find a rational motive for her act, and the defence of temporary insanity was more likely to be accepted (Walker & McCabe 1968: 127).

Despite the introduction of legislation against infanticide in 1624, it was seen as the most common form of murder in the seventeenth century (Dickinson & Sharpe 2002: 38; Kipp 2007: 125; Sauer 1978: 81). Dickinson and Sharpe's (2002: 38) study of evidence from the Cheshire Court of Great Sessions indicated that the highest number of prosecutions (eighteen) were recorded in the 1680's. Information survives for seventy cases of neonatal infanticide tried at the Northern Circuit Assizes between 1642 and 1680, from across Yorkshire, Northumberland, Cumberland and Westmorland; most of those women accused were servants, usually living in agricultural communities (Gowing 1997: 90; Jackson 1996: 49). It is likely that suspects were identified and brought to justice more readily in the country, in small parishes where the proximity of rate paying neighbours and relatives ensured that the slightest change in appearance or behaviour of an unmarried woman was readily detected, and where the body of a child could be rapidly traced to the woman concerned (Jackson 1996: 42). Whether their deaths were suspicious or not, the bodies of dead infants were not in general treated like those of adults or older children (Gowing 1997: 109). During the seventeenth century customary burial practice treated stillborn children, because they had died without baptism, differently from adults (Gowing 1997: 109). Seventeenth-century midwives were sworn simply to dispose of infants' bodies in suitable 'secret places', keeping them from animals and out of public lanes (Gowing 1997: 109). This contrasts with the medieval midwife who was empowered by the Church to perform emergency baptism if the newborn was in danger of dying (Kellum 1974: 379; Shahar 1990: 49), as we shall discuss further in Chapter five.

Some argue that the rate of infanticide actually lowered during the eighteenth century and that its frequent denunciations by writers such as Defoe, painters such as Hogarth and other public figures was the result of increased social conscience rather than the reflection of an increase in crime (Zunshine 2005: 177). Indeed, throughout the eighteenth century the percentage of indictments and convictions for infanticide appears to have declined (Cockburn 1991: 97; Hoffer & Hull 1981: 71; Kipp 2007: 126). In the eighteenth-century Cheshire Court of Great Sessions no decade experienced more than eight prosecutions and the average for that century was about five per decade (Dickinson & Sharpe 2002: 38). Between 1707-1787 there were 57 infanticide cases registered in Middlesex and London (Dickinson & Sharpe 2002: 50; Zunshine 2005: 45). On the Northern Assize Circuit, conversely, perhaps indicating other as yet undiscovered regional variations, levels of indictments for infanticide remained fairly level throughout the eighteenth century (Dickinson & Sharpe 2002: 50). The Northern Circuit records, however, demonstrate the common pattern of low levels of conviction and execution for infanticide after the early eighteenth century: of some 200 women accused of infanticide between 1720 and 1800 only six were found guilty, two of whom were hanged (Dickinson & Sharpe 2002: 50).

Nevertheless, in 1741 the retired sea captain Thomas Coram opened the London Foundling Hospital because he could not bear to see the dying babies lying in the gutters and rotting on the dung-heaps of London (Beattie 1974: 61; DeMause 1974: 29; Langer 1972: 96; Sauer 1978: 81). The hospital was designed to accept a limited number of children each year, but in 1756 a well meaning Parliament threw it open to the country as a whole (Stone 1977: 476). The results were catastrophic (Stannard 1991: 411; Stone 1977: 476; Stone 1966: 42). Three or four thousand infants poured in every year, being collected in baskets from all over the country by itinerant baby transporters, who dumped the contents, dead, dying or half alive, on the doorsteps of the hospital (Stone 1977: 476). By 1760 it was deluged with 4229 newcomers, making a total of 14,934 admissions in the preceding four years (Langer 1974a: 359), of which some ten thousand died (Stone 1977: 476).

By the mid-eighteenth century the statute of 1624 had fallen into disuse and was eventually repealed in 1803 and replaced by Lord Ellenborough's Act which reinstated the common law presumption of dead (still)birth (Lambie 2001: 73). Additionally the 1803 act made the administration of substances to bring on a miscarriage an offense (Damme 1978: 13; Scott 1999: 66). In 1823, a separate offense of concealment of birth, punishable by two years imprisonment, was created in England (Lambie 2001: 73). There were, however, other possible methods of disposal of the murdered infant; for example in 1862, thirteen unregistered infants were found in St Peter's Churchyard in London, where the sexton was running a lucrative business charging a shilling for the clandestine burial of 'stillborn' infants (Lewis 2007: 33). The law was extended in 1828 to cover mothers of all infants, whether illegitimate or not (Damme 1978: 13).

Nevertheless, in many cases, conviction for murder was difficult to achieve, as juries would readily accept the slightest suggestion that the prosecution had failed to prove that the baby had been completely delivered when it died (Adair 1996: 44; Damme 1978: 13; Gaskill 1996: 356; Goody 2000: 80; Lambie 2001: 73; Walker & McCabe 1968: 127). Much of this could be attributed to Hunter's (1818) groundbreaking treatise emphasising both the faulty reliability of the standard hydrostatic test often used as proof of the child's live birth and the unstable psychology of the frightened and physically traumatised unwed mother and the high neonatal mortality rate within the first few minutes of life (Gaskill 1996: 359; Kipp 2007: 127; Lambie 2001: 73). The result of this was that executions of mothers for the murder of their own babies became increasingly rare, and the last took place in 1849 (Damme 1978: 13; Walker & McCabe 1968: 128). The verdict was delivered on one Rebecca Smith who deliberately poisoned her infant and had probably disposed of other children similarly (Damme 1978: 13; Walker & McCabe 1968: 128).

Early nineteenth-century commentators were convinced that England was experiencing a veritable 'slaughter of innocents' (Cockburn 1991: 97), scores of accounts tell of dead infants found in rivers, canals and drains or lying under the bushes in parks and fields (Langer 1972: 96). Coroners reports show that between 1855 and 1860 inquests were held on 3,900 dead children in the London area, most of them newborn (Langer 1972: 96). In 1,120 instances the finding was murder; in 904 others it was 'accidental' suffocation (Langer 1972: 96). Reports of suffocation due to overlaying increased by threefold relative to population growth between 1850-1880 in London (vom Saal 1994: 50). In the eighteen-months ending in June 1862, inquests were held on 5,113 dead children throughout England and Wales (Langer 1972: 96).

The finding was murder in 902 cases, 297 of them in London (Langer 1972: 96). In 1862 one of the corners for Middlesex stated infanticide had become so commonplace *'that the police seemed to think no more of finding a dead child than they did of finding a dead cat or a dead dog'* (Langer 1972: 97). The *Morning Star* (June 23rd 1863) declared that infanticide *"is positively becoming a national institution",* the *Morning Post* (September 2nd 1863) termed it *"this commonest of crimes"* (Langer 1972: 97). Whilst these commentaries are possibly exaggerated, 63% of the homicides recorded in England between 1863 and 1867 involved infants and until compulsory registration of births and infant deaths was established in 1874, infanticide was easily concealed (Adair 1996: 44; Cockburn 1991: 96).

Some attributed the rise of infant mortality during the nineteenth century to parents poisoning, suffocating, or starving their children in order to collect funeral expense insurance from popular 'burial clubs' (Stannard 1991: 411). Another culprit was the rising popularity of baby farms whereby women in the factory towns, working outside the home and in no position to care for a child, entrusted their infants to hired nurses, or baby farmers, who usually cared for their charges by putting them to sleep with narcotics (Langer 1972: 97). Godfrey's Cordial, a concoction of opium, treacle and sassafras, was a great favourite with ten gallons a week being sold in Coventry alone, enough for 12,000 doses (Langer 1972: 97).

In 1922, the Infanticide Act was passed in England, outlining a specific offense, which required that the balance of a woman's mind was disturbed by reason of the effects of giving birth (Jakobovits 1978: 23; Lambie 2001: 73). This in effect created a special class of homicide rather than concealment but was a lesser offense than murder

(Lambie 2001: 73). Social and economic factors, although considered by commentators, were less frequently cited than a woman's state of mind (Lambie 2001: 73). The 1922 Act was restricted to the killing of ‘newly born’ children however, due to the legal problems presented by this ambiguous definition the law was extended in the amended Infanticide Act of 1938, which remains in force, to include all infants under the age of twelve-months as subjects of infanticide (Jackson 2006: 809).

Conclusion

It can be seen in the preceding discussion that infanticide has been practiced at different social levels by numerous societies worldwide. There are various reasons given for the practice of infanticide including population control, birth spacing, multiple births, illegitimacy, and deformity. The act is often justified by the perpetrators for its function in the economic, social or moral preservation of either one or both of the child’s parents, its older siblings or the rest of society as a whole. It was shown that in some societies there has been a preference for the use of infanticide in the regulation of the sex ratio. The decision to kill a baby on the grounds of its sex is intimately bound up with culture-specific constructions of gender, kinship, and economic structures such as dowries and patterns of inheritance. This is usually to the detriment of females with patrilineal inheritance patterns, the high value placed on male work, and associating daughters with the burdensome dowry, all instigative to preferential female infanticide. Few cases of preferential male infanticide were identified, with these only usually in times of economic hardship.

Whatever the motive for infanticide, this review has indicated that infanticide is usually a secret crime with most methods used not leaving forensically detectable traces of violence. It also highlighted the presence of other practices, including exposure and neglect, which do not cause death immediately but increase the risk of child mortality. It was shown that even in societies practicing infanticide parents tend to have a strong sentimental attachment and protectiveness towards their surviving children, though this may only apply to children that have been accepted as a member of the social group. This is not dissimilar to some of the arguments found within the philosophical literature which suggests there is a period in which infanticide is morally permissible because neonates have no conception of death and so cannot have any preference for life over death.

The examination of the history of infanticide in England indicated that the practice was at least known to the authors of the early Anglo-Saxon texts. With the introduction of Christianity to England from the seventh century there is more discussion of infanticide (both of direct murder and negligence, especially overlaying) particularly within the penitential context. However, we cannot determine whether this is a continuation of the Christian doctrine imported into England, the reaction of Christian leaders witnessing an abhorrent pagan practice within Anglo-Saxon society, or if it is merely due to the increase in documentation in the later Anglo-Saxon period. Either way, the penitential reiteration is not supported by criminal convictions for infanticide in Anglo-Saxon or medieval England. This is perhaps due to the lack of clarity in legislation or the inability to differentiate between deliberate infanticide and a natural or accidental death, during what was a period of high infant mortality. Indeed, it is tempting to suggest that the continual cautions against parental negligence and co-sleeping from the medieval Church indicate that some of the clergy were perhaps suspicious of the true cause of some of these fatalities.

There is more documentary evidence for the practice of infanticide in England after the introduction of the first specific legislation against infanticide in 1624. It is debatable as to whether this increased visibility is due to the administrative nature of the statutes and subsequent convictions, or if the statutes are in response to an increasingly immoral society in the seventeenth, eighteenth and nineteenth centuries. Or whether by strengthening the association between illegitimacy and guilt the statutes themselves augmented the use of infanticide by some desperate women in the seventeenth, eighteenth and nineteenth centuries, in a way that was not necessary within the pagan Anglo-Saxon communities or the society that existed under the dominant Anglo-Saxon and medieval Church.

This chapter has revealed that there are examples of infanticide from the Anglo-Saxon and medieval periods, and yet few of these explicitly provide motives for the crime. This review, however, has indicated several recurring motives within societies that practice infanticide and so the following chapters will examine whether these are valid motives for infanticide during the Anglo-Saxon and medieval periods. The attitude of the Anglo-Saxon and medieval society towards disability, and illegitimacy are reviewed in Chapter 4, parental attitudes to their children are discussed in Chapters 3 and 4, gender preference and the perceived value of women will be further explored in Chapters 3 and 5. These social observations will then be discussed in comparison to the osteoarchaeological analysis of the Anglo-Saxon and medieval subadult mortality profiles in Chapter 11.

Chapter 3

Differential Mortality Patterns

Introduction

The examination of the history of infanticide in England from the documentary evidence in Chapter 2 revealed Anglo-Saxon and medieval ecclesiastical and secular warnings against the deliberate killing and neglect of children. However, statutory prohibition does not necessarily indicate that the practice was widespread; indeed, the few sources containing quantitative data such as the coroners' rolls and jail delivery rolls revealed very few examples of deliberate infanticide or of overlaying. The present study is not limited to the examination of the documentary sources; rather the osteoarchaeological analysis enables us to overcome some of the limitations and biases of the historical accounts. This study seeks to investigate possible abnormalities within the demographic profile of the children recovered from Anglo-Saxon and medieval contexts. To do this we must first understand that there are distinct age and sex mortality patterns present within all human populations that can affect our interpretations of the archaeological data.

The following chapter examines patterns human mortality, evaluating the causes and rates of neonatal mortality and exploring the factors that affect the composition of the sex ratio. This includes a discussion of biological evolutionary processes looking at how parents may be shaped by natural selection to invest more in offspring of the sex expected to yield the greatest net fitness gains, examining how this is demonstrated in human sex ratios. We then consider the function of sex preference in human society, looking at how son preference can lead to deliberate discrimination against female infants and resulting in atypical male to female infant mortality ratios. The existing osteoarchaeological data and documentary records are then reviewed for any evidence of sex preference during the Anglo-Saxon and medieval periods.

Neonatal Mortality

Previous research on infanticide in archaeological populations has focused on the age-at-death profile of perinatal infants. For example, in his 1993 paper Mays concluded that the marked peak in deaths at around full term of the Romano-British infants he studied indicated the possible practice of infanticide. However, this evidence is not necessarily conclusive of any pattern other than the normal mortality rate. This is because the probability of dying is not constant with age: mortality is high in juveniles, falls to a minimum in late adolescence and early adulthood, and thereafter rises steadily with increasing age (Chamberlain 2006: 25). Infant mortality rates are, therefore, often considered to be the most sensitive indicator of general living conditions and health in past and present societies (Keeping 2000: 20). Indeed, the risk of mortality is the highest in the days immediately following birth, when the newborn infant is particularly vulnerable (Barley 1995: 179). Neonatal deaths now contribute to about 40% of all mortality in children under the age of five globally, and as much as two-thirds of infant mortality (Hall 2005: 4; Wiley & Pike 1998: 318). Each year more than 4-million babies die within 28-days after birth, with 98% of these early deaths occurring in developing countries (Hall 2005: 4).

Clinically, the majority of neonatal deaths are considered to reflect the endogenous state of the infant as the result of genetic and maternal influences (e.g. congenital anomalies, prematurity, low birth weight, birth trauma), and post-neonatal mortality is seen more as a consequence of the child's external environment or exogenous factors (infectious diseases, poor nutrition, poisonings, accidents) (Lewis 2002a: 33; Lewis & Gowland 2007: 118; Scott & Duncan 1999: 41). It has been estimated that nearly three-quarters of all neonatal deaths could be prevented if women were adequately nourished and received appropriate care during pregnancy, delivery and the postnatal period (Hall 2005: 6). About one-quarter of all neonatal deaths are caused by asphyxia and birth injuries which usually result from poorly managed labour, delivery and lack of access to obstetric services (Hall 2005: 6; Kellett 1992: 16). Studies have consistently demonstrated that low birth weight is a strong cause of neonatal mortality, and to a lesser extent post-neonatal mortality, across populations and environments (Graham 1994: 315; McCormick 1985: 83; Wiley & Pike 1998: 318). The majority of low-birth-weight babies are not actually premature but have suffered from in utero growth restriction, usually because of the mother's poor health (McCormick 1985: 88), often through the lack of an increase in dietary intake (Fuller *et al.* 2006a: 51). It is generally accepted that, in the past, children under the age of 28-weeks, or seven-months from conception, were less likely to survive the extrauterine environment due to the immaturity of their vital internal structures (Lewis & Gowland 2007: 118).

Estimated infant mortality figures from modern preindustrial populations have been found to vary widely (Bennett 1987: 68), up to approximately 200 per 1000 live births (Lewis 2007: 82; Lewis & Gowland 2007: 117). John Graunt (1662) was the first to extensively study levels of mortality in London using data from 1517-1519 where he found that in non-plague years, 36% of children under six-years-of-age could be expected to die and urban deaths exceeded rural ones (Lewis 2002a: 11). However, given the inconsistency with which stillbirths and neonatal deaths were reported in the past, this figure is likely to reflect a minimum number only (Lewis & Gowland 2007: 117). The absence of infant mortality records in England prior to the late 1550s means that skeletal remains from cemetery excavations are the primary source of evidence for infant death (Lewis & Gowland 2007: 117). The historical evidence for medieval Europe suggests that neonatal deaths were higher in rural areas than in urban communities, where environmental factors have a greater effect on child mortality, producing higher post-neonatal deaths (Lewis 2007: 84). This is supported by osteological research by Lewis (2002a: 52) where the rural sites of Raunds Furnells and Wharram Percy had higher rates of neonatal mortality compared to post-neonatal mortality, suggesting that endogenous causes of infant death were more common in these rural areas. Lewis (2002a: 52) speculates that the hard agricultural labour endured by the rural women may have resulted in the greater number of premature births observed at Wharram Percy.

There is another method of examining abnormalities in the mortality pattern that may indicate the possibility of the practice of infanticide. Children of one sex are often valued more than the other; with males usually being the preferred sex in patrilineal societies (Saunders & Barrans 1999: 189). Therefore, when such societies practice infanticide, more girls than boys are likely to be victims (Mays & Faerman 2001: 555; Molleson 1991: 121). The analysis of the sex of the children could, therefore, provide further evidence for the practice of infanticide in Anglo-Saxon and medieval England if abnormalities are found within the mortality profile. It is, however, necessary to first discover what constitutes a normal mortality pattern before we are able to interpret any abnormalities.

Male Disadvantage

From the moment of conception the mortality rate for males is significantly higher than it is for females, and this continues to remain true for all the years of life after birth (Bakwin 1928: 91; Christensen *et al.* 2001: 178; Ciocca 1940b: 60; Cook & Hanslip 1964: 79; Cowgill & Hutchinson 1963: 425; Sudha 1999: 587). This was first pointed out in a paper read before the Royal Society of London in 1786 by Dr. Joseph Clarke, a Dublin physician (Bakwin 1928: 91). The absolute differences between the mortality rates of males and females are greatest during the first postpartum year (Ciocca 1940a: 192; Coale 1991: 519; Wiley & Pike 1998: 317), where male deaths are more common by about 25% (Super 1984: 84). Males are also over-represented among spontaneously aborted foetuses, and among stillbirths (Kraemer 2000: 1609; McKee 1984: 92; McMillen 1979: 90; Waldron 1998a: 59). The latter may be due to birth trauma through the larger average size of male neonates (McKee 1984: 92). Male infants have an excessive risk of neonatal death in comparison to females (Naeye *et al.* 1971: 902).

Explanations for higher male infant mortality include higher incidence of congenital anomalies and typically higher infectious disease rates, particularly those of the digestive and respiratory tracts, suggesting a greater biological vulnerability of male infants (Fuse & Crenshaw 2006: 364; Waldron 1998b: 70). It has been suggested that the sex mortality differential at early ages is the result of genetic differences between the sexes, which are the consequence of disparity in the number of the X-chromosomes (Christensen *et al.* 2001: 179; McKee 1984: 93; Naeye *et al.* 1971: 905). The sex chromosomes are concerned primarily with sex determination, but the X chromosome also carries genetic information controlling numerous biological responses, including immunological responses (Christensen *et al.* 2001: 179; Rasmuson 1971: 45; Washburn *et al.* 1965: 57). If there are several alleles in the population capable of occupying a particular locus on the X chromosome, a given male may possess only one while a female may possess two, one of which will be active in some of her cells and the other active in occasional other cells (Christensen *et al.* 2001: 179; Naeye *et al.* 1971: 905; Rasmuson 1971: 45). Nevertheless, it is worth pointing out that Naeye and Demers (1987) also provide an explanation that implicates differing in utero environments for the differing mortality between the sexes.

The sex mortality differential is compensated for by a higher rate of male conceptions and births (Clutton-Brock 1982: 12; Judson 1994: 503; Waldron 1998a: 53). Sex ratio measures the relative distribution of the sexes and is conventionally expressed as male to female ratio (Chagnon *et al.* 1979: 291). Significant associations between birth sex ratios and the timing of insemination relative to ovulation have been demonstrated in several studies of human data (Clutton-Brock 1982: 12; Kirby *et al.* 1967: 140). Conservative estimates indicate that the primary sex ratio (the ratio at the moment of conception) is at least 120 (males) to 100 (females) (McKee 1984: 92). Nonetheless, different human populations do seem to show primary sex ratios that are biased to different extents (Judson 1994: 504; Stannard 1991: 404). Despite prenatal depredations, the secondary sex ratio (the ratio at live birth) consistently remains skewed in favour of males, at around 103-107 males per 100 females, across populations (Divale & Harris 1976: 525; Zhu *et al.* 2009: 1). With the normal pattern of higher male mortality at every age, the ratio of males to females is a maximum at birth and then declines steadily with age (Coale 1991: 519; Wiley & Pike 1998: 318; Zhu *et al.* 2009: 1).

Sex Ratio and Parental Investment

The biological evolutionary process cannot favour both maximum fertility and maximum offspring fitness – the consequence is a trade-off between the quantity and the quality of offspring (Alexander 1974: 342; McIntyre & Edwards 2009: 84; Voland 1998: 355). According to Fisher (1930) parents are shaped by natural selection to invest more in the sex of offspring that is expected to yield the greatest net fitness gains for them. Which of the two sexes is favoured depends on two factors: the differences in the per capita costs that parents incur when producing sons and daughters, and the differences in the reproductive prospects of sons and daughters (Schutkowski 2006: 221; Voland *et al.* 1997: 129). Thus it is suggested that different mortality patterns between the sexes are most appropriately interpreted as the outcome of sexual selection (Chagnon *et al.* 1979: 297). For example, Darwin (1874) believed that the tendency to give birth to more sons than daughters observed in certain cultures reflected the selective pressures arising from the tradition of female infanticide which was practiced by those cultures in earlier times (Nordborg 1992: 195; Uyenoyama & Bengtsson 1979: 732).

The Trivers and Willard (1973) model argues natural selection favours a reproductive strategy that enables parents to adjust their investment in the sexes to favour the sex with the best reproductive prospects (Cronk 1991: 38). In most mammalian species males have a greater variance in reproductive success than do females (Brittain *et al.* 1988: 679). Males in good condition are likely to be stronger and quicker and therefore more successful in the competition for a mate than are other males who are less fortunate (Brittain *et al.* 1988: 680). Trivers and Willard (1973: 91) assume that sex ratio at birth in mammals is a measure of tendency to invest in one sex more than the other and it is predicted that in many species females in better conditions tend to invest in males, and mothers in poor condition invest in females. The application of the Trivers and Willard (1973) model to humans is complicated by the tendency for males to invest parental effort in their young (which reduces variance in male reproductive success) and by the importance of kin interactions among adults (Brittain *et al.* 1988: 680; Trivers & Willard 1973: 91). Despite these complications, Trivers and Willard (1973: 91) suggest that the model can be applied to humans, arguing that the sex ratio at birth correlates with socioeconomic status. Parents with more resources at their disposal would reap a greater genetic return on their investment by raising sons, while parents with fewer resources at their disposal would maximize their genetic return by raising daughters (Brittain *et al.* 1988: 680; Cronk 1991: 38).

Dickemann (1979b: 324) presents a Sociobiological model for highly stratified societies based on the Trivers and Willard (1973) hypothesis. Dickemann (1979b: 324) argues that in stratified societies characterized by intense competition for scarce resources, male reproductive success shows extreme variance. In such societies, men of high rank acquiring access to a disproportion of females through polygyny, while those at the bottom are disproportionately excluded from reproduction through delayed marriage, heavy mortalities, and the imposition of celibate roles (Dickemann 1979b: 323). The dowry dominates the symbolic and economic index at the top of the social pyramid due to the hypergynous marriage systems, conversely, at the bottom of the socioeconomic scale, where female progeny enjoy greater probability of survival and reproduction than do males, their biological value is reinforced by the prevalence of brideprice (Dickemann 1979b: 324). Mosher Stuard (1984) critiques Dickemann's (1979b) application of the Sociobiological model to medieval European data, arguing that three of the most important characteristics of the Sociobiological model – the female dowry, endogamy, and hypergyny – do not necessarily exist together in Western societies (Mosher Stuard 1984: 412). In particular the conditions are not met in the monogamous English medieval society and whilst female dowry suits the Sociobiological model, as we shall discuss further in Chapter 5, the prevalence of the indirect dowry during much of the period precludes application of the model before the later medieval period (Mosher Stuard 1984: 412).

Gender Preference

While gender-specific infant mortality varies across nations, this fact reflects more than just the biological advantage of female infants in the first year of life (Fuse & Crenshaw 2006: 360). In some instances, deliberate discrimination against female infants is occurring, resulting in atypical male to female infant mortality ratios, a phenomenon generally caused by a preference for sons over daughters (Edlund 1999: 1275; Nordborg 1992: 195; Sofaer Derevenski 1994: 14). It is assumed that preferential treatment of males arises, at least partially, from the perception of their greater biological vulnerability and correspondingly higher death rates (McKee 1984: 93). It is also clear, however, that the well-being of female infants is mediated by women's social and economic status (Fuse & Crenshaw 2006: 362; Guttentag & Secord 1983: 19), with cultural attitudes devaluing women in past societies (Keeping 2000: 58).

Son preference and its effects on the survival and development of daughters can be demonstrated by collating demographic data on contraceptive use in relation to sex composition of surviving children, sex ratios at birth and gender-disaggregated infant and child mortality rates, nutritional status, physical development and differential access to educational and health facilities (Croll 2000: 7). Historically, preference for sons has been manifest postnatally through female infanticide and the neglect and abandonment of girls and where this persists, it mainly consists of failure to access necessary medical care (Zhu *et al.* 2009: 1). The nature of a society's key economic function is a significant factor in predicting the extent to which female infants are (dis)advantaged (Fuse & Crenshaw 2006: 371). Industrial dominance may boost only male status, whereas the dominance of service-sector employment may directly valorize female infants by transforming them from immediate burdens to future assets in the eyes of parents (Fuse & Crenshaw 2006: 371).

Even in countries where sex preference is not prominent, daughters and sons are expected to play very different roles and to serve different functions in their parents' lives (Arnold & Kuo 1984: 316; Miller 1987: 100; Raley & Bianchi 2006: 404). Sons are wanted to continue the family name and for economic reasons including old age support for their parents (Arnold & Kuo 1984: 316; Dickemann 1975: 126; Miller 1987: 100; Oomman & Ganatra 2002: 184). Daughters on the other hand, are wanted for their help in household chores, including childcare, and for a variety of desirable personality characteristics that are ascribed to them (such as obedience, reliability, beauty, lovability, responsibility, and helpfulness) and for companionship, especially for the mother (Arnold & Kuo 1984: 316; Williamson 1976: 100).

Several authors (Johansson 1984: 464; McLaughlin 1974: 120; vom Saal 1994: 59) have argued that wherever selective or negative factors were at work, they were likely to work to the disadvantage of girls, who were not highly valued in a predominantly military and agricultural society. These sex-differential treatments could lead, ultimately, to a relatively lower status if they are extended into adulthood and incorporated into sex-role structures (Fuse & Crenshaw 2006: 363; Johansson 1984: 464; McKee 1984: 95; Nordborg 1992: 195). A woman's real economic value is frequently downgraded by men of the dominant ideology, and a female infant is not necessarily deemed to be of the same 'value' as a female adult (Scott 1992: 84). Dowry systems, land inheritance, and many other customs can also be linked to a preference for sons (Fuse & Crenshaw 2006: 363), although this is not always the case (Williamson 1976: 100). However, sex preference can also be dependent on the order of birth, for example, in Rahman and Vanzon's (1993) study in Bangladesh it was observed that son preference is strong in both the early and later stages of family formation, but women also want to have at least one daughter after having several sons. In modern day South Korea and China the mortality ratios for first order births are within the normal range (approximately 104±6 in each society) but second and higher order births soar to at least 146 in China, and third and higher order births to 185 and more in South Korea (Sudha 1999: 588; Zhu *et al.* 2009: 1).

Gender perspectives suggest that the positive effects of economic development on the well being of female infants is mediated by women's social status (Guttentag & Secord 1983: 19). For example, the investigation by Fuse and Crenshaw (2006: 361) indicated a curvilinear relationship between level of development in a society and observed mortality rates; hence, boys benefit from modernization earlier than girls because male survival depends on material improvements, whereas female survival depends more heavily on social attitudes and practices (Fuse & Crenshaw 2006: 361). It should be noted that human behavioural ecologists would argue that faster male benefit is reflective of the Trivers and Willard (1973) Sociobiological theory which predicts that during times of relative prosperity, male infants would simultaneously benefit from improved mortality conditions, but also from being the more favoured sex in terms of parental investment and reproductive success (Brittain *et al.* 1988: 682; Cronk 1991: 29; Trivers & Willard 1973: 91). Nonetheless, sociocultural anthropologists have focused primarily on cultural influences on behaviour suggesting that the problem of high female mortality reflects society's attitude toward women and the economic opportunities available to them (Hanawalt 1993: 58). Intergenerational transfer of property, especially land, is important in rural areas and often influences gender preferences in children, typically by providing fewer incentives to raise girls (Choe *et al.* 1998: 208; Fuse & Crenshaw 2006: 363; Hingorani & Shroff 1995: 169; Miller 1987: 100). On the other hand, land inheritance loses much of its social and economic significance as development accelerates, suggesting that female children should experience less discrimination as non-agrarian employment begins to dominate the labour market (Fuse & Crenshaw 2006: 361).

The inferior status of women may be expected to have played a role in the division of food within the family (Fuller *et al.* 2006b: 51; Garnsey 1999: 108). In some instances, child neglect is not the result of a conscious decision because parents may simply favour some children over others (Scrimshaw 1984: 441). While women feed young children irrespective of sex, they may not necessarily feed them equally, at least after they are weaned (Garnsey 1999: 112). Lower biological and emotional support, both of which often correspond to the unconscious behaviour that may lead to infant or child death are almost always the result of maternal behaviour (Scrimshaw 1984: 449), and so women may themselves be the instruments of their own subordination (Garnsey 1999: 112).

Studies by Wells (1996: 23) and Wileman (2005: 138) of Anglo-Saxon skeletal assemblages have suggested that girls suffered more than boys, with more tooth loss, enamel hypoplasia and Harris lines; and as adults women died younger than men, often due to obstetric difficulties brought on by poor physical development. A study in Hampshire shows that the height of men increased proportionally more than that of women between the end of the Roman period and the sixth century AD suggesting boys received better nutrition (Wileman 2005: 138). Results from the isotope investigation on the fourth-to sixth-century Queenford Farm population by Fuller and colleagues (2006b) indicated differences between the male and female diet with females shown to have had a lower consumption of protein. However, it is uncertain whether this variation is influenced by individual preference, family needs, or societal values of the era (Fuller *et al.* 2006b: 52).

Some medieval medical treatises and manuals of guidance assert that the female, being biologically inferior to the male, requires less food (Shahar 1990: 81). In the thirteenth century, Arnold of Villanova writes that since the male is hotter and drier than the female, he has more strength, courage, and reason; the female is smaller in body, colder and moister, and less perfect, and so the male should be weaned later than the female (Shahar 1990: 81). In the fourteenth century, Konrad of Megenberg and Paolo of Certaldo explicitly write that the female, who is less active physically than the male because of her biological inferiority, requires less food (Shahar 1990: 81). Paolo of Certaldo points out that this does not imply discrimination against girls, since parents are instructed to love all their progeny equally, but rather indicates the need for a different mode of nurturing deriving from the biological difference (Shahar 1990: 81). Hence the author writes, *'nourish the sons well, how you nourish your daughter* *does not matter as long as you keep her alive'* (Alexandre-Bidon & Lett 1999: 82; Shahar 1990: 81). If such advice was being followed it could have caused the undernourishment of female children leading to increased morbidity and mortality (Hassan 1979: 146), and subsequently increasing the sex ratio in favour of males. However, we can never be certain how widespread the words of the few authors reached in the mainly illiterate medieval society, nor can we determine whether a parent aware of such advice would choose to adhere to it rather than to surrender to the desires of the screaming child.

Bald's Leechbook provides at least one ninth-century example of the desire for a male child with the remedy from Painting of a Hare 12: '*in order that a woman may kindle a male child, a hares belly dried, and cut into shives or slices, or rubbed in a drink; let them both, man and wife, drink it'* (Cockayne 1961c: 345). Medieval parents were also clearly interested in the sex of the next child and consulted popular almanacs and astrologers for methods of determining sex (Hadley 2000: 188; Macfarlane 1993: 54). From the medieval texts we have some indication of belief in the superiority of the male in the superposition that the male child lay on the right side of the womb and the female on the left, and the suggestion that clear and fresh complexion in the pregnant woman was a sign that she was carrying a boy (Alexandre-Bidon & Lett 1999: 64; Shahar 1990: 43). Some medieval authors believed that over-ardent intercourse between husband and wife could cause the birth of deformed and weak males or of females (Shahar 1990: 43).

Despite the medieval interest in the sex of the next child there are few indications that in the middling ranks the absence of sons was considered the disaster it is held to be in many Third World countries today (Macfarlane 1993: 54). The medieval authors apparently conceded that girls were desired, for the woman who wanted a daughter was instructed to dry the testicles of a hare, and, at the end of her monthly cycle, to ground them into a powder and prepare a potion, which she was to drink before copulation (Shahar 1990: 43). Furthermore, in the thirteenth century, Bartholomeus Anglicus wrote that girls are better disciplined, more careful, more modest and timid, and more graceful and, he thought, dearer to their mothers than boys (McLaughlin 1974: 137; Steele 2010: 48). Hanawalt (1986: 102) noted that medieval English sources do not contain the usual peasant complaints over the liabilities of excess female children. All children presented their parents with the burden of support while young and the hope of labour when grown, but boys were also preferred heirs upon whom both family names and family lands would devolve (Bennett 1987: 69; Hanawalt 1993: 58). Certainly by the sixteenth and seventeenth centuries it would appear that both sons and daughters were welcomed, with only a slight preference for sons particularly for those with large estates, but even at this high level of society there was a desire to mix the genders (Macfarlane 1993: 53).

Sex Ratios in Anglo-Saxon and Medieval Society

The markedly higher number of males than females during the early Middle Ages has led some to suggest that the practice of preferential female infanticide was prevalent due to the low value and low status of women as well as the custom of dowry (vom Saal 1994: 59). For example, female infanticide was speculated as the cause of the higher sex ratios among the heirs listed in the *Inquisitions Post Mortem* from about 1250 to 1348 and again from 1430 to 1545 (Boswell 1989: 409; Damme

1978: 2; Kellum 1974: 368). When the records began in the mid-thirteenth century, the ratio of male to female children was about equal, but during the two periods mentioned above, the ratio grew to four (males) to three (females) (Kellum 1974: 368). In another, perhaps even more striking instance, from the 128 children of serfs recorded on the land of John of Hastings in 1391-2, 78 were male and 46 female, leading Russell (1948: 166) to observe *"either the liquidation of females among the serfs was much more common than among the favoured classes or there is some peculiarity in the collection of the evidence".* The demographic study by Coleman (1971) of the 801-820 Polyptych of Saint Germain-des-Prés monastery near Paris showed a startlingly high sex ratios ranging from 110.3 to 252.9 men for each 100 women (Coleman 1976: 49; 1971: 209). Coleman (1971: 209) discounts the possibility of under-reporting of women and instead argues that on the smaller less populous, and less productive farms, female infanticide was practiced out of necessity to rid families of potentially unproductive and economically unsupportable mouths (Coleman 1976: 55; 1971: 208; Kellum 1974: 369; Nelson 1994: 92). However, Mosher Stuard (1984: 411) points out that whilst the ninth-century rural French peasant communities revealed high male sex ratios, the affluent French families from the same era showed much larger numbers of offspring and nearly equal sex ratios.

Engels (1984: 388), however, argues against the widespread practice of preferential female infanticide stating that baptismal records indicate sex-ratios were in balance during infancy, and whilst the numbers of males increased between the ages of fourteen and forty this was suggested to be the result of higher mortality rates among women of childbearing age. Medieval society in the central middle ages was acquiring a marked plurality of women over men (Herlihy 1985: 102). For example, the 1185 survey *Rotuli de dominabus*, which shows the distribution of sexes among the offspring of wards of King Henry II, females outnumber males by 155 to 138 (Herlihy 1985: 102). The reason for this seems to be that the professional preoccupation with war during Henry's reign eroded the ranks of young noblemen who were the social group made up of professional fighters (Herlihy 1985: 102; Thrupp 1966: 477).

For infanticide to lower populations significantly, it must be directed at enough female infants to reduce the number of mothers who could bear in the next generation (Hoffer & Hull 1981: 114). The study of the fifteenth-century Canterbury Act books by Helmholtz (1975: 385) shows clearly that infanticide occurred in practice, and that the Church courts undertook prosecution against it; what is harder to assess with accuracy is what the records prove about contemporary attitudes towards infanticide. There is no evidence in the fifteenth-century Canterbury Act books to suggest that female children were killed more often than male as the sex of the child is not given (Helmholtz 1975: 385). By contrast, the sex of infants whose deaths brought murder indictments recorded between 1558 and 1624 from Hertfordshire, Sussex, Middlesex, and London indicates a slightly higher proportion of male victims with 43.9% male (61 cases) and 41.7% female (58 cases) (Hoffer & Hull 1981: 114).

If infanticides were being concealed by accidental deaths, then one might expect a higher proportion of female infants to appear among the cases. However, in Hanawalt's (1998: 168; 1986: 102) studies of accidental deaths listed in the coroners' rolls and jail delivery rolls (AD 1265-1413), it is the males that suffer from more accidents although the ratio between the sexes is quite close. Two studies by Gordon (1991; 1986) on the miracles in the *Lives of the Saints* observed greater proportions of boys to girls receiving aid; 145 boys to 57 girls in the earlier study and 81 boys to 46 girls in the latter. The greater number of boys in this series is not surprising; although many hazards are different, more boys than girls are injured in modern figures (Gordon 1991: 149; Kraemer 2000: 1610). In any case, individual anecdotes show that many parents were devoted to their daughters, demonstrated the same degree of concern, grief, and despair noted in the accounts of boys, and did not hesitate to seek aid for them (Gordon 1991: 149; Gordon 1986: 507).

Conclusion: Manipulation of Mortality Patterns

This chapter discussed the patterns of human mortality looking at the probability of mortality for different ages and between the sexes. This questioned the conviction of previous archaeological researchers that the practice of infanticide may be observed solely through the presence of high neonatal mortality. Instead, it was argued that a more convincing interpretation may be provided through an analysis that incorporates both age and sex demographics. This is because the majority of societies practicing infanticide tend to eliminate children of one sex before the other. It was recognised that in order to make any interpretations from the sex profile of the Anglo-Saxon and medieval subadults it was necessary to first identify the factors that affect the composition of the human sex ratio. This review revealed that the human population has a genetic predisposition for higher male conception and mortality rates. It was posited by biological evolutionary theorists that natural selection favours a reproductive strategy that enables parents to adjust their investment in the sexes to favour the sex with the best reproductive prospects. It was shown that sex ratios can also be affected by culturally endorsed opinions of the different sexes. In particular, it was observed that the son preference seen in many societies has caused the deliberate discrimination against female infants, resulting in atypical male to female infant mortality ratios.

This chapter showed that some previous researchers speculated that the high number of males recorded in some medieval accounts had been caused by the preferential infanticide of females, argued to be due to the low value and status of women and the associated high cost with the custom of dowry. In actuality the proportion of males and females found within medieval accounts vary. Whilst there examples that show sex ratios to be in favour of males, there are other accounts where the number of females outnumber males and some records with a balanced number of the two sexes. In those few medieval prosecutions of infanticide where sex of the child is recorded there is actually a slightly higher proportion of male victims, and again males are recorded in higher numbers in the list of accidental deaths in the coroners' rolls and jail delivery rolls (AD 1265-1413). However, there does appear to have been differences in the nurturing of the two sexes. The osteoarchaeological analysis of Anglo-Saxon assemblages suggested that boys received better nutrition and were in better general than their female counterparts, and some of the medieval authors suggested that the female required less food due to their biological inferiority. The perceived value of women in Anglo-Saxon and medieval society will be further discussed in Chapter 5.

In sum, although sex ratios do vary across cultures, the high ratio of male conceptions to female, as well as the greater mortality susceptibility of males would suggest that, in a normal mortality situation, we would expect more male than female children to be recovered from the archaeological record. On the other hand, if there are a disproportionately large number of female children within the archaeological populations it may be possible that an abnormal mortality profile has occurred. Abnormal mortality can reflect a culturally determined sex preference of males that encourages greater nourishment and maternal care for male children, or even the preferential infanticide of female children. The osteoarchaeological analysis presented in Chapter 10 will, therefore, analyse the mortality profile of the Anglo-Saxon and medieval children for any abnormalities that could be indicative of deliberate infanticide or neglect, the findings of which will be discussed in Chapter 11.

Chapter 4

The Anglo-Saxon and Medieval Child

Introduction

The discussion in Chapter 3 indicated that there are differences in mortality rates dependant on age. The challenge is that we must determine whether our age-at-death profiles are the result of natural mortality or affected by cultural practices adversely affecting children, such as infanticide. The immaturity of children is a biological fact of life, but the ways in which this immaturity is understood and made meaningful is a fact of culture (Hill & Tidsall 1997: 3; Prout & James 1990: 7). Childhood is socially constructed; it is not 'natural', but shaped in crucial ways by cultural and social context (Chamberlain 1997: 249; Hill & Tidsall 1997: 12; Parker-Pearson 2002: 103; Prout & James 1990: 8). Past societies did not construct infancy and childhood in the same way that we do today (Scott 1999: 65) there are ethnocultually variable boundaries and diversity in the immature of our species and the way they are treated within different cultures (Chamberlain 1997: 249; Sofaer Derevenski 1994: 10; Tucker 1977: 99). As it was discussed in Chapter 2, it is common for societies to have 'waiting' period after birth where the child is not considered fully human. This enables actions, such as infanticide, to be performed on the individual that would not be acceptable with a fully accepted member of society.

The discussion of the practice of infanticide in human society in Chapter 2 indicated that when infanticide is undertaken as a calculated act the perpetrator often first considers the social, moral and economic values of the infant and small child against those of older children, adults and the family unit as a whole (Blaffer Hrdy 1992: 412;

Scheper-Hughes 1987: 2). This chapter, therefore, examines the status of the child in Anglo-Saxon and medieval society. The Anglo-Saxon documents suggest that the society not only had words for children (*cild, bearn*) but also for the state of childhood (*cildhad*), and, perhaps most importantly could identify and describe behaviour relevant to childhood: childish (*cildisc*), childishness (*cildsung*) (Crawford 1999: 45). Social historians have challenged Philippe Ariès' (1962) view that there was no place for childhood within medieval society, instead citing many sources including the posthumous miracles, medical manuscripts, artistic representations, literary, ecclesiastical, and legal documents that contain abundant evidence to the contrary (Gordon 1986: 520; Hill & Tidsall 1997: 14; Pollock 1993: 263; Scott 1999: 65).

Following from some of the ideologies discussed in Chapter 2, this chapter explores the possibility of parental indifference in Anglo-Saxon and medieval England that could allow infanticide to be more acceptable. It discusses the position of the disabled or illegitimate child within Anglo-Saxon and medieval society and the likelihood that these could have been motives for infanticide. The superstitions surrounding children within the Anglo-Saxon and medieval folklore are discussed in relation to the society's attitudes to children and the potential of these tales to promote infanticidal practices. The function of baptism is investigated to discuss the timing of the acceptance of the child into Christian society (and cemeteries) and the potential of deviant burial within the Christian period.

Parental Compassion towards Children

It is often argued that, as a kind of cultural defence mechanism, high infant mortality produces parental indifference (Lyman 1974: 91; Scheper-Hughes 1987: 14; Tooley

1983: 413). This can be perpetuated through ideologies in which infants have low status (Scott 1992: 87; Tucker 1977: 19). Societies often feature a ‘waiting’ period after birth where the child is not considered fully human until accepted as a member of the social group (Barley 1995: 179; Scrimshaw 1978: 393; Ucko 1969: 270).

Some Anglo-Saxon sources suggest parental compassion towards their children, for example the poem *The Fates of Man* from the tenth-century Exeter Book evokes a picture of loving parents doting over their child, and illustrations to the Psalms in the eleventh-century *Harley Psalter* include scenes of parents holding their children’s hands, cuddling them and caressing them (Crawford 2001: 104; 1999: 4). Several of the Anglo-Saxon law codes also indicate that children warranted protecting (Härke 1997: 126), for example, Æthelbert of Kent (602-603?) Law 25: ‘*If a man slays the dependant of a commoner, he shall pay [the commoner] 6 shillings compensation*’ (Attenborough 1922: 5; Crawford 1999: 175; Whitelock 1979: 391-394). This protection was also extended to god-sons in Ine of Wessex (-726) Law 76: ‘*If anyone kills someone’s god-son or his god-father, the sum to be paid to them equal to the amount paid to the dead man’s lord*’ (Crawford 1999: 175). Arguably these laws could just indicate the desire for economic compensation of the lost assets (both the time and expense of raising the child and also lost potential future labour) or perhaps the legislation just shows an understanding of the greater vulnerability of children, however it may also possibly be suggestive of the society’s compassion for their young.

In the fourteenth-century coroner’s rolls Hanawalt (1977: 21) discovered several examples where a parent risked their own life to save their child, including an Oxford mother who died in an attempted rescue of her twenty-week-old son from their burning home, which is suggestive of strong parental affection for their children. The violent grief of the mothers and fathers so often noted in the miracles reminds us that medieval parents were as capable of feeling anguish as modern (Finucane 1977: 109). In the eighth-century Life of St. Wilfred, Stephanus describes how the saint came across a woman *‘sad at heart, moaning with grief and wearied with her load. For she held at her bosom the body of her first born child’* (Colgrave 1927: 38-41). A medieval woman collapsed and nearly lost her mind when she learned that her son had fallen into a ditch and drowned, while another was so deranged with grief that she kept the body of her child for five days and refused to allow burial (Finucane 1977: 109).

Whatever the cause of the accident, the parents of these medieval children were often beside themselves with grief and remorse, and their pleas for celestial aid were tearful and desperate (Gordon 1991: 160). In the twelfth century one mother reportedly begged St Thomas Becket for help for her five-year-old daughter who had apparently drowned: *"Return my daughter to me, 0 Martyr Thomas. If anyone is guilty, I alone, her mother, must bear the blame. I, who did not order supervisions of her childish wandering*” (Gordon 1991: 160). Perhaps it is such parental remorse that led to the Law 88,8 of Henry the First (1106-1135): ‘*No one is obliged to make amends for his own child who he did not kill intentionally, neither by way of money compensation nor by physical mutilation’* (Downer 1972: 273).

It would seem that theologians and preachers expected parents to accept the birth and the death of children with the same composure for *‘The Lord giveth and the Lord taketh away’* (Shahar 1990: 151). They condemned exaggerated mourning of parents more directly as the expression of lack of faith and piety (Shahar 1990: 151). The ninth-century canon which prohibits parents to mourn in an excessive way, by cutting their hair and lacerating their faces with a sword or with their nails, does itself suggest that there existed an emotional bond between parents and children, though it is not clear if this canon speaks of very young, or already adult children (Meens 1994: 59; Nelson 1994: 93). In the fourteenth century John Wyclif emphasises the sinfulness of non-submission to the will of God as he castigates bereaved mothers for their tears and cries saying *"See now the madness of this murmuring. It is a great mercy of God to take a child out of this world"* (since it will reach the next world as an innocent) (Shahar 1990: 151). Wyclif's remarks were intended both to rebuke and to comfort bereaved mothers and to prepare them for the possible death of additional children (Shahar 1990: 151). In a tract written by a 'god wyfe' of London in the fifteenth century for her daughter, she advises her to foster spiritual readiness to accept fate, which will enable her to acquiesce in the death of her children without rebelling against God (Shahar 1990: 151). Interestingly, Pollock's (1993) study of sixteenth- and seventeenth-century diarists showed young infants were not mourned as deeply as older children; it seems as if parents grieved at the death of a baby for what that infant would have become whereas, at the death of an older child, they grieved not only for what the child would have become, but also for what the child had been (Pollock 1993: 141). However, we cannot be sure if this pattern of greater mourning for older children was a continuation from the medieval ideology or developed in the early post-medieval period, perhaps as a response to the high infant mortality associated with the rising popularity of the use of rural wetnurses and suckling houses (McLaren 1978: 387).

Disability in Anglo-Saxon and Medieval Society

The observation of parental grief provides some indication of parental compassion; however, it is well known that such sensibilities are not equal either between different parents or between different children of the same parents. In particular both physical and mental deformities are common reasons for child neglect or for infanticide, even within modern western society (Fábrega 1997: 236; Fletcher 1975: 75; McMahan 2002: 345). The Anglo-Saxon law codes, however, provide some evidence to suggest that parents would take on long-term care of their sick children rather than abandon them (Crawford 1999: 172). For example, Law 14 of Alfred the Great (871-99): '*If anyone is born dumb or deaf, so that he cannot deny or confess his sins, his father shall pay compensation for his crimes*' (Crawford 1999: 176), also indicates that at least some deformity was accepted within Anglo-Saxon society.

There also some possible archaeological examples of individuals from the Anglo-Saxon period who survived childhood with congenital deformities; including two possible cases of Down's Syndrome; one from Breedon-on-the-Hill in Leicestershire and the other from Nazeingbury in Essex, and the supposed congenital absence of the left arm of the individual from grave 38 at Worthy Park (Crawford 1999: 96; Hawkes & Wells 1983: 9; Roberts & Cox 2003: 179). Also the man aged between seventeen and twenty-five buried at Raunds, Northamptonshire (5218) who, it was thought by the excavators, had suffered from severe deformities as a result of contracting poliomyelitis and tuberculosis arthritis (Boddington 1996: 41; Powell 1996: 120). Crawford argues that this individual's survival of a disease contacted in childhood is indicative of real care of a deformed child in the later Anglo-Saxon period, evidence which directly contradicts any theory that juveniles were regarded as 'disposable goods', or that no care was given to them until they reached maturity (Crawford 1999: 96). It should, however, be recognised that there is an ongoing debate amongst osteoarchaeologists regarding the validity of the pathological diagnoses of some of these published cases, consequently we must be cautious with our interpretations and inferences of social practices from these examples.

Perhaps some of the more convincing evidence for parental compassion come from the *Lives of the Saints*, which show that parents raised their congenitally handicapped children and even undertaking long journeys to bring them to the shrines of the saints, because they were convinced that their offspring, no matter how impaired, were worth helping (Gordon 1986: 517; Nelson 1994: 91; Shahar 1990: 148). For example, the twelfth-century monk, Thomas of Monmouth describes a helpless eight-year-old girl who had such severe contractures that until a visit to St. William's shrine she was totally-dependent on the care of her devoted family (Gordon 1986: 518). In another depiction related by Thomas of Monmouth we read how a father brought his handicapped son, bent double by spasticity and contractures, from his village of Wortham to Norwich in a wheelbarrow, a distance of over twenty miles (Gordon 1986: 518). William of Malmesbury, another twelfth-century monk, describes a father and his blind and retarded son, whose arms and legs were in constant motion, set out on horseback for a forty-five-mile pilgrimage from Malmesbury to Worcester; the father wrapping the boy very carefully in a soft enveloping, cloak of wool and supported his head to prevent injury (Gordon 1986: 518).

There are, however, still some examples of parental despair at the birth of a disabled child, such as the French woman who moaned *"Oh God, why was he not* *carried away from my womb to a grave?"* (Finucane 1977: 106). Whilst it is possible that the medieval belief that the production of a deformed infant was thought to reflect a mother's sins increased the probability of neglect or even infanticide of mentally and physically handicapped children (Hanawalt 1986: 102; vom Saal 1994: 58). However, research by Hanawalt indicated the occasional medieval 'village idiot' inherited land, suggesting the survival of mentally disabled children to adulthood, although it is also possible that the idiocy developed later in life (Hanawalt 1986: 103). Mental illnesses often do not cause a physical disability the sufferers are consequently less recognisable as 'different' and may be considered more acceptable by a community than an individual with a visible disablement. The majority of mentally disabled individuals, therefore, would be virtually undetectable through osteological analysis and, if accepted by the living community, would also quite possibly be afforded normative community burial rites. Whilst the evidence may be sparse toward the acceptance of deformed children there is less to indicate that they were rejected on a large scale, thus little argument for the widespread abandonment or infanticide of deformed infants.

The Position of the Illegitimate Child

The status of a child in society and its value to the parents is often dependent on the legitimacy of parentage (Bell 1997: 237). Illegitimate children often lack a proper position in a society, usually because the children are a constant reminder of illicit deeds, their situation can cause exclusion or undesired attention for themselves and their mothers. Subsequently illegitimacy is often a cited reason for infanticide (Daly & Wilson 1984: 493; Pinchbeck 1954: 310; Williamson 1978: 66). Generally illegitimate children are the result of not only unrecognized unions but also of pre-marital intercourse (Goody 1983: 192). However, there was great ambiguity and conflict in the legal definition of illegitimacy in Anglo-Saxon and medieval England due to its dependence on the local definitions of marriage (Laslett 1980: 9; Stone 1977: 31). For example, medieval church law considered all children to be legitimate if their parents were married, no matter when the marriage took place (Macfarlane 1980: 73).

It is difficult to assess how far any stigma attached to an illegitimate pregnancy may have been relevant in the pagan Anglo-Saxon period (Crawford 1999: 63). In *Germania* Tacitus indicated that the fourth-century Germanic peoples showed a high moral stance towards illicit unions (Wemple 1993: 227), however, Crawford (1999: 63) warns of the political agenda of this work which attempted to shame the Roman audience by highlighting the immoralities of their society in comparison to the uncorrupted barbarian savages. By contrast, later Christian writers looking back on the pagan Anglo-Saxon period had a vested interest in demonstrating how immoral the pagan forbearers were (Crawford 1999: 64). Nevertheless, the change in the Old English vocabulary concerning marriage and sexual relationships which took place during the course of the Anglo-Saxon period gives a clear indication of the change in attitudes and customs which was brought about by the Church's rulings on the issues of legality and legitimacy in marital affairs (Clunies Ross 1985: 18). Those relationships, like concubinage, which had previously been recognized, became illegal, and the offspring of such unions became illegitimate and so debarred from the inheritance of family property (Clunies Ross 1985: 18; Goody 1983: 76; Stone 1977: 31).

Kings in particular, were castigated for having several wives, as witnessed by Boniface's stiff letter to King Æthelbald of Mercia in 746, who nonetheless had 'improper' relationships (Crawford 1999: 64). It is highly likely that concubinage was in fact practiced much more extensively among the upper classes, than in the lower social ranks (Clunies Ross 1985: 3; Herlihy 1985: 52). The high priority that the missionary church attached to the establishment of 'lawful marriage' led to the 673 Council of Hertford condemning all multiple marriages (Hollis 1992: 55). This is repeated in Wihtred of Kent's (695) Law 3: *'Men living in illicit unions shall turn to a righteous life repenting of their sins, or they shall be excluded from the communion of the church'* (Attenborough 1922: 25-31; Whitelock 1979: 396-397). Perhaps a hint of coercion can be read in Ine of Wessex's (688-694) Law 27: *'Whoever begets an illegitimate child and does not acknowledge it, has no right to the wergild at its death, but its lord and the king [will have it]'* (Attenborough 1922: 37-61; Whitelock 1979: 398-403).

The admonitions in Chapter Twelve of the Legatine Commission which visited England in 786 during Offa's reign, however, suggest that Anglo-Saxon custom had not previously excluded royal bastards from the inheritance of the kingship (Clunies Ross 1985: 27). Indeed, in the eighth century Bede writes favourably of the Christian King Aldfrith, despite his being the bastard son of Oswy, indicating that at least in the case of royalty in the early Christian period, an illegitimate child was not necessarily unwanted and would not be stigmatised in its later career (Crawford 1999: 64). Complaints about polygamous unions persist into the late Anglo-Saxon period, and their frequency perhaps reflects a commonplace practice (Crawford 1999: 64; Stone 1977: 30). The Viking period Law 4 of Edward and Guthrum (-890) legislated against two brothers or near relatives having one wife (Attenborough 1922: 103-109; Crawford 1999: 177), while Æthelred’s (978-1016) Law 5 attempted to deal with priests having two or more wives (Crawford 1999: 64). As late as 1020, the Northumbrian Priests' Law 61 still found it necessary to insist that *'we forbid that any man should have more wives than one; and she is to be lawfully betrothed and wedded’* (Stone 1977: 30; Whitelock 1979: 471-476).

Illegitimacy in medieval England was considered to be a moral offence which concerned God and hence was dealt with by the ecclesiastical court (Macfarlane 1993: 240). The usual punishment was public confession and humiliation, but these could be avoided by a monetary payment (Laslett 1980: 49; Macfarlane 1993: 241). However, if an unmarried woman bore a child as the result of an adulterous union, the civil courts became involved (Clark 1994: 148; Macfarlane 1993: 241). Church and civil law were unanimous in requiring one or both parents to take responsibility for illegitimate offspring (Boswell 1989: 345). Whilst the father was legally obliged to contribute to the support of all children borne out of wedlock within his means, the standards were variously enforced in the secular world with the manorial courts often fining the mothers the *childwyte* fine for children born out of wedlock but not the fathers (Clark 1994: 150; Jewell 1996: 66). The court rolls from Halesowen from the pre-plague period imply that for each 1.9 women who married, one woman gave birth to a child out of wedlock, the incidence of illegitimacy was greater for those of lower socio-economic status in the village (Goody 1983: 258; Razi 1980: 66). In the second half of the fourteenth century, when it became easier for girls to marry with small or no means, the number of fines recorded in the Halesowen court rolls fell considerably, thus suggesting that poverty rather than licentiousness was the reason for the large number of women who bore children out of wedlock (Goody 1983: 258; Razi 1980: 69).

In spite of ecclesiastical condemnation of unlawful conception there is little evidence of social stigma associated with illegitimacy in England before the sixteenth century, the bastard suffered under none of the harsh disabilities which degraded him in continental lands, such as loss of freedom or of personal rights (McLaughlin 1974: 121; Pinchbeck 1954: 313). Certainly William the Conqueror made no disguise of his illegitimate origin, and frequently styled himself William the Bastard (Pinchbeck 1954: 313). His son, King Henry the First, is famed for being the English King with the largest number of acknowledged illegitimate children, numbering at least twenty. In medieval Halesowen, illegitimate children were not treated as outcasts by their families or by the village community and whilst they were not allowed to inherit land, some of them obviously did, also many of the women who conceived and bore children out of wedlock subsequently married and not below their status (Razi 1980: 65). English common law declared that a bastard could not inherit by right but that did not mean that he could not inherit (Given-Wilson & Curteis 1984: 48). Whilst in medieval London law barred bastards from inheriting the chief estate, it did not prohibit people from making other provisions for them through bequests of movable property or usage of real estate (Hanawalt 1993: 59). The apparent lack of social stigma toward illegitimate children or their mothers in Anglo-Saxon and medieval sources would argue against illegitimacy as a reason for widespread infanticide during these periods.

The Role of Children in Folklore

Due to the nature of the documentary evidence surviving from the Anglo-Saxon and medieval periods, there is a lack of emotional descriptions of children or of how they are valued within society. However, it is possible that a careful study of the folklore will provide further interesting insights. These superstitions beliefs tend to be revolved around the fear not only of the evils that can occur to living children, but also a fear of dead children and reincarnation (Barley 1995: 192). In either case they are arguably in response to the high infant mortality rates (Barley 1995: 192; Crawford 1999: 90).

There are hints within the documentary sources that suggest towards the belief that a dead infant could in some way influence or prevent birth. For example, in a charm from the late Anglo-Saxon text *Lacnunga*, a woman who had miscarriages was to take a bit of her own child's grave, wrap it in black wool, sell it to a trader and then say: *'I sell it, I have sold it, this black wool and these grains of sorrow'* (Crawford 1999: 83). The disturbance of grave sites has generated a variety of folklore (Barber 1988: 137), including the Nordic dead-child belief that beings rose from the bodies of murdered (usually unbaptised) children and returned to haunt their families, to suckle from their mothers or even to kill them (Hanawalt 1986: 101; Kellum 1974: 380). Kellum (1974: 380) claims that their British counterparts were also known to haunt woods and if a person inadvertently walked over one of their graves that person contracted the fatal disease of the 'grave-merels, or grave scab'. The particularly interesting point here is that the possibility of inadvertently walking over a grave would suggest that the burial was unmarked and also that such unmarked graves of infants were common enough to appear within the folklore.

The death of an unbaptised infant not only caused grief but also raised fear, inspired by a combination of the Christian conception as to the infant's fate and archaic customs and beliefs originating in pre-Christian times (Kellum 1974: 379; Shahar 1990: 51). Infants who died unbaptised were regarded as unclean and perhaps as fearful objects that might return from the dead (Gilchrist & Sloane 2005: 72; Kellum 1974: 380). One of the few means of ridding oneself of such a monster was to posthumously baptise the being (Kellum 1974: 380). Medieval people also regarded water as an effective barrier to the undead: precautions taken to stop the dead walking included pouring water behind the coffin during the funerary procession (Gilchrist & Sloane 2005: 72). Burchard of Worm's eleventh-century '*Decretum*' also referred to the custom of burying an unbaptised infant with a stake through its heart so that it would not arise and injure (Duby 1998: 14; Kellum 1974: 379; Shahar 1990: 51).

Probably the most common folklore theme is that of 'changelings'. This encouraged the belief that fairies or the devil might replace a good child with a bad one, which embodies the parents' fear both of a difficult to manage child and for the child's safety (Alexandre-Bidon & Lett 1999: 12; Boswell 1989: 380; Kellum 1974: 379; McLaughlin 1974: 155; Shahar 1990: 92). Boswell (1989: 380) observes that the 'changeling' motif almost exclusively involved legitimate children of married couples, with the description of a being that continuously craves and demands human milk; the realisation of an petulant and hungry, but very real child (Kellum 1974: 379). The idea of the 'changeling' led to the extraordinary and often brutal practices aimed at reversing the exchange. These practices included placing the child close to the fire so that the changeling would disappear up the chimney vent, another suggestion within the folklore was to put the suspected changeling in a basket actually hung over the fire; if the child screamed, as it naturally would, it was a changeling and was to be dealt with accordingly (Kellum 1974: 379; McLaughlin 1974: 156; Meens 1994: 60; Shahar 1990: 132). The concentration on placing the child near the fire is reminiscent of the twelfth-century penitential warnings such as that from Bartholomew of Exeter who condemns superstitious people including *“whosoever shall have set his child on the house-roof or in an oven or furnace to recover its health”* (Blair 2006: 167; Meens 1994: 60).

Other methods used to revert a changeling included laying the child down at a place where roads or rivers crossed, sometimes with the suggestion that a dead body should be carried over the being before the ‘true child’ could appear (Kellum 1974: 387; Shahar 1990: 132). In Burchard of Worm’s early eleventh-century ‘*Decretum*’ we learn of the practice of passing a crying infant through a hole supposedly offering it to the evil powers in return for another less difficult child (Alexandre-Bidon & Lett 1999: 12; Duby 1998: 14; Meens 1994: 60). There are also warnings to mothers against the devil’s work of drawing children through the earth from both Ælfric’s *Lives of the Saints* from the late tenth century and also from the early eleventh-century law of Canute (Crawford 1999: 90).

In the medieval period folklore shifted to the deeds of witches who snatch children and devour them, although these stories incorporated the belief in changelings (Shahar 1990: 132). An early example could be seen in the description by John of Salisbury 1154: ‘*infants are set out for lamias [a witch who sucked the blood of children] and appear to be cut up into pieces, eaten, and gluttonously stuffed into the witch’s stomachs. Then, through the mercy of the witch-ruler, they are returned [in one piece] to their cradles’* (Kors & Peters 1973: 37). Similarly in the fifteenth-century *Malleus Maleficarum* we read that ‘*Sometimes evil spirits remove women's sons and* *daughters and put strangers in their place. These children, called 'changelings' in common parlance, are of three different kinds…All three kinds have [this) in common. They are very heavy, they stay thin and do not grow, and, as I said before, no flow of milk can satisfy them'* (Maxwell-Stuart 2007: 200-201).

Interestingly we also find that folklore was used to remove some of the culpability from negligent parents. In particular witches were often provided as scapegoats for accidents that happened to medieval children for example in one of his fourteenth-century sermons John Myrc claimed that it was vicious '*fendys [fiends]...thay make wymen to overlye hor children'* (Kellum 1974: 375). Similarly in the fifteenth-century *Malleus Maleficarum* '*While small children are walking beside water, they* [evil spirits] *know how to hurl them into it right under their parents' eyes, with no one else seeing'* (Maxwell-Stuart 2007: 127-129). The lowly village midwife who would have had some elementary knowledge of herbs and potions was usually the considered the suspect in matters involving witches and doomed children (Kellum 1974: 375). Thus the *Malleus Maleficarum* declared that the midwife-witch would take any opportunity she could to get the child out of the mother's sight in order to offer up the new born to the devil (Kellum 1974: 375). *'Midwives who work harmful magic kill foetuses in the womb in different ways, procure a miscarriage, and when they do not do this, they devour the child, or offer it to an evil spirit'* (Maxwell-Stuart 2007: 92-3). This is perhaps most famously reflected in the passage from Shakespeare's *Macbeth* (written between 1603 and 1607) where among the many things the three witches threw into their cauldron was a '*Finger of birth-strangled babe, Ditch-delivered by a drab'* (Stone 1977: 474).

Midwives were not the only suspects in medieval tales; in the later twelfth century the charge that Jews stole, bought, and killed Christian children, became very widespread and did incalculable harm to Jewish communities for centuries thereafter (Boswell 1989: 352; Kellum 1974: 376). The Jews were accused of murdering Christian children in order to use their blood for baking *matza* (unleavened bread) for the festival of Passover, a particularly irrational motive given that kosher laws prohibit the tasting of even animal blood (Kellum 1974: 376; Shahar 1990: 135). Nevertheless, Jewish communities across medieval England suffered persecution; for example, when in 1168 the body of a Christian child missing for twenty-two days was found in the River Severn near Gloucester, Jews were accused of torturing and crucifying him (Boswell 1989: 352; Kellum 1974: 376). Similar charges were also levelled in Winchester in 1192 and 1232, in Lincoln in 1202 and in London in 1244 and 1255 (Boswell 1989: 352; Kellum 1974: 376). This theme also appears in Chaucer's fourteenth-century *Prioress's Tale* where we hear of a seven-year-old boy who, when walking through the Jewish quarter while singing 'Alma Redemptoris', was murdered by one of the Jews and was thrown into a privy-drain (Baron 1979: 77; Shahar 1990: 135).

By 1272 the problem was widespread enough to warrant recognition from Pope Gregory X *"it happens that [when] some Christians lose their Christian children, the Jews are accused by their enemies of secretly carrying off and killing these same Christian children and of making sacrifices of the heart and blood of these very children. It happens, too, that the parents of these children, or some other Christian enemies of these Jews, secretly hide these very children in order that they may be able to injure these Jews, and in order that they may be able to extort from them a certain* *amount of money by redeeming them from their straits"* (Boswell 1989: 353). It is not clear whether negligent Christian parents blamed the Jews simply to have another scapegoat, or whether Jewish families sometimes took in abandoned Christian children and were then accused of stealing and killing them if they died (Boswell 1989: 354).

This review of Anglo-Saxon and medieval folklore has indicated a fear of infants rising from the dead probably as a consequence of improper burial of infants (possibly infanticide victims) either in location or their shallow burial which caused grave disturbance by animals. It is unlikely that such stories could have promoted any institution of infanticide. However, the majority of folklore discussed here reflects society's acceptance of the struggles of parenting within a period of high mortality rates by appropriating blame away from the (possibly negligent) parents.

Infant Baptism

A common theme from the folklore is that baptism would prevent the reincarnation of dead infants. It would hardly be surprising if some members of the medieval church perpetuated some of the folktales to encourage the swift baptism of babies. The baptismal status of an individual during this period would have a significant consequence on their acceptance within society and subsequent portrayal within the burial record. It is often reported within the archaeological literature that the low recovery of infants from Christian Anglo-Saxon and medieval cemeteries is due to the exclusion of unbaptised infants from consecrated ground (Daniell 1997: 127; Finucane 1981: 54; Gilchrist & Sloane 2005: 72; Kellum 1974: 374). However, any such interpretation would be dependent on a baptismal ritual being unavailable for very young or very sick infants. It is, therefore, important for this study to examine the methods and availability of baptism to comprehensively discuss the consequence of early mortality on the representation of infant from archaeological contexts.

Baptism was a defining moment when the child, and the soul, was brought into the society of the church and the community (Daniell 1997: 127). A long Christian tradition argued that the human infant, having been born in sin as the fruit of the sexual intercourse of its parents, which since the Original Sin have been marked by carnal lust, and as the heir of the sin of Adam and Eve, must be cleansed of the sin of its conception and heritage through baptism immediately after its birth (Finucane 1981: 54; Hanawalt 1986: 172; Shahar 1990: 14). The taint of Original Sin meant that unbaptised infants made up one of the proscribed groups that were not buried in Christian cemeteries (Finucane 1981: 54). There had been a general supposition on the part of theologians from Augustine of Hippo in the fifth century through to the twelfth century that unbaptised infants resided in hell, even if they were not actively tormented (Boswell 1989: 398; Crawford 1999: 85; Foot 1992: 188; Lyman 1974: 88; Meens 1994: 59; Shahar 1990: 45). This became increasingly unsatisfactory to the medieval theologians, and in the thirteenth century, St. Thomas Aquinas articulated a belief in 'limbo', which became the received wisdom among theologians, usually described as the uppermost region of hell where the only suffering was a denial of the Beatific Vision of God afforded the saved (Boswell 1989: 398; Daniell 1997: 10; Donnelly & Murphy 2008: 212; Finucane 1981: 54; Shahar 1990: 45). Christian doctrine therefore considered it a graver offence to kill a child that was not yet baptised, because it had not been given a chance to save its soul (Meens 1994: 57).

The teachings of the Anglo-Saxon Church reiterated that children, even though they had no understanding, had to be baptised, although there seems to have been some resistance to this idea (Crawford 1999: 85). At the end of the Anglo-Saxon period, Ælfric felt obliged to reiterate the idea that infants had to be baptised, even though they could not understand the ritual (Crawford 1999: 85). St Augustine's eighth question to Pope Gregory at the turn of the seventh century, according to Bede's eighth-century account, was about baptism, including how soon after birth an infant could be baptised, particularly of it was in danger of dying (Crawford 1999: 85). In his response to St Augustine's eighth question, Pope Gregory stated that baptism should *'be administered without delay to the dying; for if we wait to offer them this mystery of redemption, it may be too late to find anyone to be redeemed'* (Crawford 1999: 85; Latham & Sherley-Price 1968: 77). Several of the canons of Theodore's seventh-century Penitential, clearly considering infant baptism to be ideal, appointed penalties for its non-performance: if the parents were responsible for failing to have a child who died in infancy baptized, a penance of one year was imposed; but should the child have been as old as three at its death and still unbaptised, a period of three years penance was prescribed (Foot 1992: 188).

Secular authorities also started to reflect the uptake of Christian values such as the uncompromising Law 2 of King Ine of Wessex (reigned 688-72): *'A child shall be baptised within 30 days. If this is not done, [the guardian] shall pay 30 shillings compensation. If it dies without being baptised, he shall pay for it with everything he owns'* (Attenborough 1922: 37; Crawford 1999: 85; Foot 1992: 188; Whitelock 1979: 398). To fail to baptise the child was not a serious offense – thirty shillings was not a large penalty compared to fines for other crimes – but to allow a child to die unbaptised was (Crawford 1999: 85). The reiteration of the law indicates that many parents were reluctant to baptise their apparently healthy infants; perhaps there was an unintentional correlation in their perception between death and baptism (Crawford 1999: 86). The Northumbrian Priests' Law 10 (probably 1020-1023) reinforced the haste to baptise '*we instruct that every child is to be baptised within nine days, under penalty of 6 ores [Danish coins]. And if a child dies heathen within nine days, through carelessness, amends are to be made to God, without a secular fine; and if it occur after nine days, amends are to be made to God, and 12 ores to be paid for the [lack of] care, that it remained heathen so long'* (Crawford 1999: 86; Whitelock 1979: 472).

Anglo-Saxon priests were charged to ensure that they never refused to perform the ministry of baptism, and those who failed through negligence were directed to cease from their ministry until corrected by their bishop (Foot 1992: 185; Meens 1994: 59). Similar sentiments may account for the inclusion in secular law codes of statements of the punishments due to priests who failed to perform the sacrament of baptism when required (Foot 1992: 185). For example, Wihtred of Kent (695) Law 6 states: '*If a priest permits an illicit union, or neglects the baptism of a sick person, or is so drunk that he cannot [perform it], he is to abstain from his ministration until the bishop's sentence'* (Foot 1992: 185; Whitelock 1979: 396). The seventh-century penitential of Archbishop Theodore also ordered the deposition of any priest who refused to baptize a weak infant or a sick adult commended to him before that person's death (Foot 1992: 185). Finally the law of the Northumbrian priests (probably 1020-1023) Law 8 states: '*If a priest refuses anyone baptism or confession, he is to pay 12 ores compensation for it, and above all to make zealous supplication to God'* (Whitelock 1979: 472). There is very little documentary evidence indicating whether or not there is any gender discrimination in baptising infants, but the few references that do exist feature both boys and girls as part of the narrative, therefore it would appear that late Anglo-Saxon boys and girls were equally entitled to the sacrament of baptism (Power 2007: 43). Indeed, Bede noted that the very first Northumbrian to receive baptism was Eanflaed, the newly born daughter of King Edwin on the feast of Pentecost in 626AD (Crawford 1999: 86).

If a newborn baby appeared on the edge of death, the Church empowered lay people to baptize it so that it would not die in Original Sin (Hanawalt 1986: 172; Shahar 1990: 49). If a priest was unavailable such baptism (*in articulo mortis*) could be conducted by any man, or even woman, and those present were obliged to do so as a Christian duty (Hanawalt 1986: 172; Shahar 1990: 49). If during delivery it appeared that the child would be stillborn, the midwife was permitted to baptise any limb which emerged (Shahar 1990: 49). John Myrc included in his fourteenth-century *Instructions for Parish Priests* a long involved section of advice to midwives on emergency baptising techniques for infants even if only halfway out of their mother's body if it appeared that they were going to die (Kellum 1974: 379; Shahar 1990: 49). The midwife should sprinkle water on any limb which emerged from the birth canal and pronounce the following sentence: *'God's creature, I hereby baptise thee in the name of the Father, the Son, and the Holy Ghost'* (Hanawalt 1986: 172; Shahar 1990: 49). If the child survived, its parents brought it to the church as soon as it was sturdy enough in order to complete the baptism; the priest anointed it was consecrated oil and exorcised Satan (Shahar 1990: 49). In all representations of baptism, the infant is depicted as naked, and this exposure to cold (even though it was recognised that infants required heat) indubitably endangered the health of infants, nor was the baptism water necessarily clean (Hanawalt 1986: 173; Shahar 1990: 46). Given the relative ease of this emergency baptism there should have been very few children who were not baptised at least in this informal manner (Daniell 1997: 128).

Conclusion: Children in Anglo-Saxon and Medieval Society

This review has indicated that Anglo-Saxon and medieval parents were as capable as modern parents of feeling parental compassion, and anguish, towards their children. There is evidence in the law codes and in the *Lives of the Saints* to suggest that parents would take on long-term care of their sick children rather than abandon them, which is supported by possible archaeological examples of individuals who survived childhood with congenital deformities. This chapter has also revealed that, in spite of ecclesiastical condemnation of unlawful conception, there is little evidence of social stigma associated with illegitimacy in England before the sixteenth century. Nevertheless, this discussion has only focused on children as a demographic group and, as was discussed in Chapter 3, it should be noted that there could be other social attitudes that could cause the devaluation of girls in particular during Anglo-Saxon and medieval England so this will be explored further in Chapter 5.

The majority of folklore discussed here reflects society's acceptance of the struggles of parenting within a period of high mortality by appropriating blame away from the (possibly negligent) parents, the consequences of whose actions were discussed previously in Chapter 2. Whilst it would hardly be surprising if some members of the medieval church perpetuated one of the more common themes from the folklore, that baptism would prevent the reincarnation of dead infants, given the relative ease of emergency baptism, there should have been very few children who were not baptised at least in this informal manner (Daniell 1997: 128). This would argue against the common supposition that the low recovery of infants from Christian Anglo-Saxon and medieval cemeteries is due to the exclusion of unbaptised infants from consecrated ground, though this will be discussed further in Chapter 7.

Chapter 5

Women in Anglo-Saxon and Medieval Society

Introduction

In Chapter 4 we discovered that Anglo-Saxon and medieval parents cared for their children, showing compassion towards their offspring even when their children were inflicted with debilitating illnesses. That discussion, however, just focused on children as an age group, yet in Chapter 3 it was identified that there can be cultural attributes within a society that affect the perceived value and subsequently the treatment of the different sexes. The often used argument for the higher number of males than females recorded from Anglo-Saxon and medieval contexts is that it was a consequence of a prevalent practice of preferential female infanticide due to the low value and low status of women through cultural mechanisms such as high dowry. All too often though, these statements are based on outdated assumptions that are usually formed on comparisons from ethnographical data or other well documented historical periods. Whilst it is true that preferential female infanticide would require some form of cultural mechanism to devalue females within the society, rarely within the archaeological literature do we encounter a thorough investigation on the social position of women within Anglo-Saxon and medieval society.

To allow for a comprehensive discussion on the possibility of preferential female infanticide in Anglo-Saxon and medieval England, it is fundamental that we extend the analysis of sex preference presented in Chapter 3. This will be conducted through an examination of the social value of women in Anglo-Saxon and medieval England to determine if there are cultural factors that may cause the devaluation of females to the degree that parents may choose to deliberately kill their daughters. This will explore the legal position of women during the Anglo-Saxon and medieval periods, considering their potential economic contribution to both family and the society. The discussion of marriage patterns reviews those factors required for a legally binding matrimony in Anglo-Saxon and medieval England, followed by an examination of the movement of marital property during these unions. This pays particular attention to any traditions of brideprice, bridewealth and dowry payments which, as was discussed in Chapters 2 and 3, could affect the perceived value of children based on their gender. Gender preference is again questioned in the review of female inheritance patterns from Anglo-Saxon and medieval wills and charters.

The Woman's Role in Anglo-Saxon and Medieval Family and Society

It has often been said that the Anglo-Saxon woman lived a life of relative independence particularly in the ownership and inheritance of land (Clunies Ross 1985: 7; Page 1970: 66). Care for an Anglo-Saxon woman's financial security, however, was largely in her family's hands (Herlihy 1985: 48; Page 1970: 72; Power 2007: 42). The father retained the right of making matrimonial arrangements for his daughter, a right that passed to his widow, or if she died or remarried, to the brother of the daughter or her paternal uncle, or to a guardian (Clunies Ross 1985: 9; Wemple 1993: 229; Whitelock 1961: 45). The Anglo-Saxon document *Concerning the Betrothal of a Woman*, which survives in the *Textus Roffensis* but unfortunately gives no clear indication of date, stresses that if a woman moves into another district her own kinsmen must have the right to protect her and to pay if she commits an offence, for a woman did not enter into her husband's kindred when she was married (Whitelock

1979: 54). A woman kept her father's *weregild* status upon marriage, rather than taking her husband's (Page 1970: 72).

Laws advocating that widows and orphans should be properly looked after are commonplace: Law 78 of the Kentish King Æthelbert (602-603?) advocated that *'If a wife bears a living child, she shall have half the property left by her husband, if he dies first'* (Attenborough 1922: 5-17; Brentano 1966: 150; Crawford 1999: 175; Ward 1992: 26; Whitelock 1979: 391-394). The implication must be that the heir of the man's estate needs protection and this would best be ensured by providing its mother with means of sustenance (Crawford 1999: 127). The seventh-century Law 6 of Hlothhere and Eadric (673-685?) from Kent similarly made provision, for *'If a man dies leaving a wife and child, it is right, that the child should accompany the mother; and one of his father's relatives who is willing to act, shall be given him as his guardian to take care of his property, until he is ten years old'* (Attenborough 1922: 19-23; Crawford 1999: 175; Whitelock 1979: 394). Ine of Wessex (688-694) Law 38 provides additional details of the maintenance given '*If a man and his wife have a child between them, and the man dies, the mother will keep and rear the child: she will be given six shillings to maintain it, a cow in summer and an ox in winter. The kinsman will look after the property until it comes of age'* (Attenborough 1922: 37-61; Crawford 1999: 175 - 176; Whitelock 1979: 398-403).

From the legal family framework it is clear that the rights of maidens, wives and widows were protected suggesting that women were valued members of the household in Anglo-Saxon society (Fell *et al.* 1984: 62; Herlihy 1985: 100). But it is also fairly clear that attitudes to women were more stringently dominated by their class than their sex, and the degree of protection afforded operated within a rigid hierarchal pattern (Fell *et al.* 1984: 62). Most documentary sources relate to women of aristocratic rank; less information is available for women of the lower classes, but legal and testamentary texts show that female slaves were employed as corn-grinders, serving maids, wet-nurses, weavers and seamstresses, while other occupations pursued by women appear to have included baking and cheese-making (Crawford 2001: 486; Herlihy 1985: 52). Women of *ceorl* class and above were responsible for the management of their own households, and it is possible that the key shaped 'girdle-hangers' found in female graves from the early period symbolize the control of domestic economy (Crawford 2001: 486; Herlihy 1985: 52; Page 1970: 72).

Within the aristocracy, Anglo-Saxon women fulfilled many important administrative functions, from managing estates to making yearly gifts to the knights at court (Fell *et al.* 1984: 62; Herlihy 1985: 100). One strong example is that of Aethelflaed, the eldest child of Alfred the Great and known as Lady of the Mercians, who controlled Mercia for seven years after her husband Aethelred's death in 911, vigorously resisting Viking aggression (Page 1970: 70). In the surviving heroic poetry the noble woman plays a decorative part, as a gracious hostess, a generous rewarder of warriors, the central figure of a diplomatic marriage contract which will reconcile warring peoples (Page 1970: 66). One of the periphrases for 'woman' in Old English is *freothuwebbe*, 'weaver of peace', and the daughter of a royal house must often have been used to heal enmity between peoples or to cement friendship (Page 1970: 69). One example was Aethelburh, the daughter of the Christian king Aethelberht of Kent, who was asked by the Pope to use her influence to bring her husband, the pagan King Edwin of Northumbria, into the Church (Page 1970: 69).

With the foundation of the great double monasteries ruled by abbesses during the seventh and eighth centuries, the monastic life served as an acceptable refuge for women who did not wish to be married and provided opportunities for women to express themselves intellectually and artistically (Keeping 2000: 82; McLaren 1990: 104). Aristocratic widows used them as retirement homes which kept them within their own class but placed them in a protected sphere of social activity (Goody 1983: 65; Keeping 2000: 82). On entering the nunnery a woman added her portion to the endowment of the house where she could live comfortably under royal protection (Goody 1983: 66). The institutions offered significant opportunities for women to attain positions of authority with influence in both the Church and in the secular world, with leading figures within the documentary sources including Hild of Whitby, Cuthburg of Wimborne and St Æthelthryth of Ely (Crawford 2001: 486; Keeping 2000: 82; Page 1970: 70).

Unlike the Anglo-Saxon houses, the women in the later medieval nunneries were not exclusively drawn from the aristocratic classes, but included recruits from those social classes who provided most of the financial support for female monastic houses (Keeping 2000: 91; Power 1922: 14). Unless she had a very strong calling to the religious life, however, there was really no practical reason for a peasant girl to enter a nunnery because she had a vital economic role to play as a source of surplus labour in secular society (Keeping 2000: 92; Power 1922: 14). They had an avenue of relative independence that was not available to women of the upper and middle classes for whom only widowhood and/or the convent offered any degree of independence and social influence (Keeping 2000: 92). Probably the real factor in determining the social class from which the convents were recruited was not one of rank but one of money

(Power 1922: 16). The practice of demanding dowries from those who wished to become nuns was strictly forbidden by the monastic rule and canon law (Power 1922: 16). This sentiment was, however, in practice set aside from early times; and a glance at any convent register, such as the famous Register of Godstow Abbey, shows something like a regular system of dowries, dating certainly from the twelfth century (Boswell 1989: 320; Mosher Stuard 1984: 411; Power 1922: 17).

The partnership between husband and wife was central to the medieval household as an economic unit (Goldberg 2006: 429). In rural society roles were probably more gender specific, but in urban society wives were an essential part of the artisanal workshop (Goldberg 2006: 429). In medieval manorial records women appear in a variety of capacities as property owners, brewers, bakers, cultivators, weavers and plaintiffs or defendants in business matters (Hanawalt 1976b: 127). However, the growth of bureaucratic offices in the medieval period limited the importance of women as administrators (Herlihy 1985: 101). The misogyny of the medieval Church reinforced such disparity of roles, rights and social status, which were also inscribed in the legal and political systems of the day (Roberts & Cox 2003: 278). Guilds dominate cloth production within towns, and only under special circumstances could women become guild members subsequently diminishing their role in economic production, especially in cities (Herlihy 1985: 101). The contribution of women is limited to such relatively unskilled work as spinning and washing (Herlihy 1985: 101). The contributions women made through service or skill to their families thus diminished, especially in the middle ranges of society and especially in cities to the point where families were no longer eager to retain the services of daughters (Herlihy 1985: 101).

Anglo-Saxon and Medieval Marriage Customs

From the Anglo-Saxon period until Hardwick's Marriage Act of 1753, a marriage was valid without banns or licence, at any hour, in any building, there was no necessity for a clergyman to be present, or for any religious ceremony (Macfarlane 1993: 310). In Anglo-Saxon England the betrothal or pledging of the couple to each other was in effect the legally binding 'wedding' act, the betrothal combined with consummation constituted the marriage (Macfarlane 1993: 309). Similarly the medieval contract *per verba de praesenti* by which the pair exchanged before witnesses such phrases as 'I do take thee to my wife/ husband' was regarded in ecclesiastical law as an irrevocable commitment which could never be broken (Macfarlane 1993: 128; Stone 1977: 32). It was this ceremony, not the one in church, which created the binding legal obligation (Goody 1983: 147; Kellum 1974: 377; Stone 1977: 32; Wemple 1993: 234; Whitelock 1961: 152), although the Church did make several attempts to make the wedding more public (Bennett 1987: 92; Given-Wilson & Curteis 1984: 28). Some 70% of the marriages involved in cases heard in Ely between March 1374 and March 1382 took place in private surroundings (Goody 1983: 147).

The 614 decree of Coltaire III stated that the woman had to agree to marriage (McLaren 1990: 104). This is repeated in the late text surviving in the *Textus Roffensis* which defines the ordering of the betrothal of a woman; the consent of both the woman herself and her kinsmen is needed, the man must pledge to maintain the woman's property, must announce what he will give her for accepting his suit, and what she will get if he predeceases her, this should be half his goods, or all if they have a child together, unless she remarries (Clunies Ross 1985: 8; Page 1970: 73). By contrast, towards the end of the Anglo-Saxon period Cnut's (1020-1023) Law 74 recognizes a woman's right to determine whom she should marry: '*And neither a widow nor a maiden is ever to be forced to marry a man whom she herself dislikes, nor to be given for money, unless he chooses to give anything of his own free will*' (Clunies Ross 1985: 8; Crawford 1999: 177; Whitelock 1979: 454-467).

Marriage in medieval England continued to be contracted through the mutual consent of the couple themselves; with the ecclesiastical model supporting the common laws based on old Germanic custom (Given-Wilson & Curteis 1984: 27; Goody 1983: 151; Hanawalt 1986: 97; Macfarlane 1993: 126; Stone 1977: 30; Ward 1992: 14). However, it is clear that parents, employer, lord, and friends could all advise and even put enormous physical, moral and economic pressure on the individuals (Dyer 1989: 157; Goldberg 2006: 423; Hanawalt 1986: 97; Macfarlane 1993: 128). Consequently this period also sees the development of dowry; for whilst a father could not force a daughter to marry against her will, customary and statute law often deprived her of a dowry if she married against his wishes (Goody 1983: 153). The relative frequency of cases alleging forced marriage emanating from the more prosperous levels of peasant society and from the gentry may be indicative of a higher degree of parental involvement and influence in making marriages (Goldberg 2006: 423).

Transition of Property through Marriage

It would appear that the system of 'indirect dowry' (that is from husband to wife) which was practiced within the confines of Germanic law, as observed by Tacitus in his *Germania* (18.1) (Mattingly & Handford (trans.) 1975: 116), was continued within the realm of Anglo-Saxon rule, as opposed to Roman 'direct dowries' from the wife's family to the husband (Saller 1984: 199; Wemple 1993: 227). The text *Concerning the*

Betrothal of a Maiden, mentions an indirect dowry in the shape of the 'morning-gift' which is the husband's present to his wife the day after the consummation of the marriage, as well as the promise of a dower (Goody 1983: 254; McNamara & Wemple 1988: 87). Two Old English marriage agreements also stress the endowment of the bride by the groom (Goody 1983: 254). In the first, Wulfric promises Archbishop Wulfstan (1003-1023) that when he takes his sister as wife, she will have various lands, some for her lifetime, some for her disposal, together with *'50 mancuses of gold and 30 men and 30 horses'* (Goody 1983: 254; Page 1970: 73; Whitelock 1979: 593). In the second agreement, from Kent around 1016-1020, was that '*which Godwine made with Brihtric when he wooed his daughter; first, namely, that he gave her a pound's weight of gold in return for her acceptance of his suit, and he granted her the land at Street with everything that belongs to it, and 150 acres at Burmarsh and in addition 30 oxen, and 20 cows, and 10 horses and 10 slaves*' (Goody 1983: 254; Page 1970: 73; Whitelock 1979: 596-597). A woman had control of her 'morning gift', if she died childless her own kinsmen inherited it and she herself retained it after her husband's death, unless she married again within a year (Fell *et al.* 1984: 57; Goody 2000: 53; Herlihy 1985: 50; McLaren 1990: 104; Whitelock 1961: 151).

It is interesting to note that none of these examples mention a bridewealth payment (made by a groom or his kin to the kin of the bride), nor yet of a direct dowry (where the bride's family gives the bride property to bring to the marriage), rather all the property goes directly from the husband to the wife (Goody 1983: 254). The system of indirect dowry that appears to be present within Anglo-Saxon society argues against the often used economic motive for preferential female infanticide. The only mention of the girl's family making a payment to the groom is if the agreed marriage fails to take place as is indicated in Ine of Wessex's (688-694) Law 31: *'If anyone buys a wife and the marriage does not take place, he [the bride's guardian] shall return the bridal price and pay [the bridegroom] as much again, and he shall compensate the trustee of the marriage according to the amount he is entitled to for infraction of his surety'* (Attenborough 1922: 37-61; Crawford 1999: 175 - 176; Goody 1983: 249; After 1979: 398-403).

In much of medieval Europe the terms of marriage were shifting to place the chief 'burdens of matrimony' once again on the bride and her family (Herlihy 1985: 98). For example in the early fourteenth century Dante remarked in the *Devine Comedy* that the size of dowries was exceeding all reasonable measure, and he harkened back to better days, in the eleventh and twelfth centuries when the birth of a daughter did not strike terror into her father's heart (Herlihy 1985: 99). However, in English documentary sources there is very little evidence of indebtedness caused by providing daughters with large dowries, suggesting that English parents were not prepared to cripple themselves to pay marriage portions to daughters (Macfarlane 1993: 271). Whilst the dowry was present in medieval English marriage agreements the overall value varied enormously from the equivalent to about three years' income for the gentry to perhaps one or two years income at husbandman level with the portion of a labourer's child even smaller, it is likely the really poor would probably have no portion (Goody 1983: 258; Macfarlane 1993: 264). Instead the girl's portion came from different sources with only part coming from her parents, this would supplement any savings she had kept from employment over a period of years, and often employers provided an extra gift much in the way that friends and neighbours would give presents, in poorer cases the community may even have made a charitable contribution to the woman’s portion (Macfarlane 1993: 268). Therefore the woman could only have a portion of what was already available meaning there was a distinct advantage to delaying the marriage to obtain a larger portion (Macfarlane 1993: 271).

The common law of England, taking shape in the last years of the twelfth century, influenced the position of women and property in two ways, first by insisting that any plea of land be held before the secular rather than the ecclesiastical courts, and second, by limiting the proprietary capacity of a married woman (Goody 1983: 66; Herlihy 1985: 100; Kellum 1974: 378). In 1205 King John of England declared that widows could no longer claim on half of the acquisitions made by their households while their marriages endured, but were to be content with their dowers (Herlihy 1985: 100). While she retained ownership of her lands, a woman's movable property, her chattels, fell not under the *control* of the husband, as in some of the community systems of Europe, but under his *ownership* (Goody 1983: 66; Herlihy 1985: 100; Macfarlane 1993: 272). On the other hand, he could not legally dispose of her dower - the property which she would take over on his death (Goody 1983: 66). Moreover, when separation or death occurred, both canon and common law agreed that a married woman was entitled to the return of the property she had brought into the marriage (Goody 1983: 66). Before about 1200 the wife's dower in land or goods was assigned to her by her husband at the church door at the time of the marriage, or she might receive one-third of the lands held by her husband at that time (Ward 1992: 27). The 1217 and 1225 versions of Magna Carta assigned to her one-third of the land that her husband had had in his lifetime, unless she had been dowered with less at the church door when the marriage was solemnized (Ward 1992: 27).

Inheritance Patterns in Anglo-Saxon and Medieval England

The laws governing inheritance in Anglo-Saxon times are nowhere stated, yet from surviving wills we see that practices were at least superficially egalitarian in nature that is, in the absence of mitigating circumstances, widows and male and female offspring could expect equal shares of their husband's/father's property (Crawford 1999: 13; Goody 1983: 18; Power 2007: 42; Whitelock 1961: 153). For example, when King Alfred wrote a will (probably around 879-888) favouring his sons over his daughters (specifically designed to ensure that his son Edward had the political power to succeed to the throne after Alfred's death), Alfred felt a need to explain and justify his decision (Crawford 1999: 13; Goody 1983: 254; McNamara & Wemple 1988: 90; Whitelock 1979: 534-537). Some of the major land-holders recorded in the Domesday Books are women; while toponyms preserving the names of female owners or lessees include Bamburgh, received by the Northumbrian queen Bebbe as her 'morning-gift' during the seventh century, Bilbury, inherited by Beage during the eighth century, and Wolverhampton, given to Wulfrun in 985 (Crawford 2001: 486; Page 1970: 71).

Wills and charters show that women were able to acquire and dispose of property on their own authority by record of law-suits brought and defended by women, and by place-names reflecting the prominence of women within society (Crawford 2001: 486; Whitelock 1961: 152). The eleventh-century will of Leofgifu disposed of a dozen estates in Suffolk and Essex, while Wynflaed left land in Wiltshire, Berkshire, Hampshire, Oxfordshire and Somerset (Page 1970: 71). In the absence of primogeniture, daughters could inherit equally with sons and in general the testators show no marked preference for male as opposed to female heirs (Crawford 2001: 486). Indeed, in the old English will of Wulfwaru (984-1016) she divided her property including land more or less equally between her two sons Wulfmrer and Ælfwine and two daughters Gode and Ælfwaru right down each child receiving '*two cups of good value'* (Goody 1983: 244; Whitelock 1979: 567-568).

In most of western Europe between about 1000 and 1200, legal, social, and cultural structures began to incorporate mechanisms to allow the maintenance of estates in the hands of a single heir (Boswell 1989: 271). In England this was achieved by the gradual legal establishment of systems of primogeniture, whereby the eldest son automatically inherited the majority of the estate and titles (McLaren 1990: 106; Stone 1977: 43). For example Law 70, 21 of Henry the First (1100-1135) *'The first born son shall have the father's ancestral fee; the latter shall give any purchases and subsequent acquisitions of his to whoever he prefers'* (Downer 1972: 225). In the absence of male heirs, however, daughters continued to have inheritance partitioned equally among them which caused fragmentation of the property (Bennett 1987: 69; Flandrin & Southern 1979: 76; Ward 1992: 2). It is probable, however, that this rule of the right of primogeniture was not really applied among the peasants, and it is known that partition among the sons of the deceased person survived as late as the sixteenth century in the mountainous areas of the north and west, and in the lowlands of Yorkshire, Norfolk and Kent (Dyer 1989: 158; Flandrin & Southern 1979: 76). Even in the areas of impartible inheritance, where the holding descended intact to a single son, fathers went to much trouble to provide the children who were not inheriting any of the main holding, both sons and daughters, with parcels of land acquired by clearing new land or by purchase (Dyer 1989: 158).

Conclusion: The Social Value of Women in Anglo-Saxon and Medieval England

The Anglo-Saxon documentary sources indicate that women were protected by the legal framework, being both guarded by and accountable to their family even after marriage. Women were responsible for the management of the household and safeguarding of the storeroom, a role that provided some influence particularly for aristocratic women. The Anglo-Saxon monasteries provided a social sphere in which the aristocratic woman could become independent of her family and gain respected authority. The lack of a dowry and apparently egalitarian inheritance system in Anglo-Saxon sources suggests against the application of the Trivers and Willard (1973) hypothesis discussed above in Chapter 3. Furthermore, these marriage and inheritance systems argue against an economic motive for preferential female infanticide as a daughter's marriage does not result in large amounts of assets moving out of the family. Rather we have the pattern of indirect dowry which could symbolize the requirement for the groom to show his ability to provide for his wife.

The growth of bureaucracy in the medieval period limited the importance of women as administrators and, although still important in artisan industry, the rise of male dominated guilds also reduced their economic potential outside of the family business and some devaluation of medieval women. The introduction of the dowry during the medieval period may have been both as a consequence of, and also resulting in, coerced marriages. Yet the dowries recorded in the English texts are not at the devastatingly high amounts reported elsewhere in Europe. Furthermore, the rising age of marriage and increase of waged labour meant that English dowries were savings amassed by the bride over a number of years not just an outlay for her family. While we see the gradual establishment of primogeniture in the medieval period, daughters were not necessarily completely overlooked as they continued to inherit although in the absence of male heirs. Even with the rise of the dowry and legal systems of primogeniture in the medieval period it is difficult to fully apply Dickemann's (1979b: 324) Sociobiological model discussed above in Chapter 3, as we are still confronted with the human tendency for males to invest parental effort in their young. Through investment in all their children, even in the areas of impartible inheritance, and by not providing their daughters with the largest possible dowry, the medieval father would be reducing their reproductive success according to the Trivers and Willard (1973) hypothesis, and thus not conform to Dickemann's (1979b: 324) Sociobiological model. Therefore, even with the rise of the dowry in medieval England, it does not appear to be at such a high level to suggest that women were viewed as a significant economic detriment to cause despair, thus we do not find a convincing argument for preferential female infanticide. It was, however, shown in Chapter 2 that environmental and economic constraints on family resources can affect the desirability of additional children, these population pressures are influenced by fertility rates. Therefore, the factors affecting fertility and the implications these had in Anglo-Saxon and medieval England will be discussed further in Chapter 6.

Chapter 6

Fertility in Anglo-Saxon and Medieval England

Introduction

The cultural attributes that affect the perceived value of women in Anglo-Saxon and medieval society were examined in Chapter 5. Little evidence was found to suggest that women were devalued to the degree that would provide a convincing argument for preferential female infanticide in Anglo-Saxon and medieval England. Nonetheless, as was shown in Chapter 2, the perceived value of a child is dependent on the environmental and economic resources of both the family and the society. These are affected by fertility rates and population pressures. Fertility patterns play an important role in mortality rates with high fertility influenced by the synergistic interaction of environmental parameters, economics, and cultural restraints, expressed for example in birth rates, weaning practices, and food taboos that may buffer or induce stress in a specific population (Bennike *et al.* 2005: 734; Chamberlain 2006: 25; Krause 1959: 177; Weiss 1976: 359). Lower levels of fertility are associated with higher chances for female infant survival, probably because it places fewer demands on family resources (i.e. food, health care, education), thereby leading to a more gender-neutral distribution of such resources (Fuse & Crenshaw 2006: 371). Fewer children boost the value of each, mitigating against infanticide (Fuse & Crenshaw 2006: 371).

The fertility patterns during the Anglo-Saxon and medieval periods will have played a significant role in the population structure and access to resources on both a societal and familial level, and would, therefore, have influenced the use of family limitation techniques including infanticide. Differences in fertility can be attributed to two factors: the differential exposure of women of childbearing age to the risk of childbirth through cohabitation with a sexual partner, and differences in the rate at which conceptions and live births occur among women who are cohabiting (Coale 1974: 45). Human fertility is directly influenced by health and nutrition as well as individual reproductive behaviour which is affected by custom (Chamberlain 2006: 35; Coale 1974: 46; Read & LeBlanc 2003: 62).

This chapter examines the many factors that would aid and inhibit fertility in Anglo-Saxon and medieval England, starting with the effect that the nutrition may have had on health and fertility during these periods. An investigation is made on the age of marriage in Anglo-Saxon and medieval England as this can greatly affect the reproductive capabilities by defining the number of years a couple can, legitimately, procreate. The Anglo-Saxon and medieval understanding of hazards associated with childbirth is examined because high female mortality during child bearing years can have a dramatic affect on fertility by reducing the sexually reproductive population. This chapter also looks at the lengths Anglo-Saxon and medieval women would go to avoid becoming pregnant, and the risks they would take to abort unwanted progeny. A discussion of taboos surrounding procreation follows, reviewing those practices that could have impacted on fertility rates including the Church's restrictive demands of marital continence.

The nursing habits of Anglo-Saxon and medieval women are also considered because customs surrounding breastfeeding can have a direct influence on fertility levels, due to the period of postpartum amenorrhea provided by maternal nursing. This is followed by a discussion on the Anglo-Saxon and medieval patterns of infant feeding;

looking at the possibility of artificial feeding, the use of wetnurses, and the age of commencement and completion of weaning, all of which have an effect on infant morbidity and mortality and the fertility levels of the society as a whole. Finally this chapter reviews the fertility success of Anglo-Saxon and medieval society through the analysis of population levels and family size.

Health and Fertility in Anglo-Saxon and Medieval England

It has been argued that remedies to provoke menstruation in the Anglo-Saxon and medieval medical texts are indicative of 'famine amenorrhoea' whereby ovulation is inhibited during and after unusual physical or mental trauma, especially the stresses associated with famine (Crawford 1999: 58; Finucane 1977: 105; Stone 1977: 64). Short supply of fresh foods, meat, fruit and vegetables particularly during the winter months might be expected to have caused serious deficiencies of vitamins A and C as well as iron during the Anglo-Saxon and medieval periods (Crawford 1999: 58; Howe 1997: 80; Roberts & Cox 2003: 195). Nutritional deficiencies will have been exacerbated by the commonplace intestinal parasites such as roundworm, whipworm and tapeworm (Roberts & Manchester 2005: 219). The presence of endemic malaria in the Anglo-Saxon population, particularly rife in the Fen country, the marshes of the Thames and south-east Kent, could also have contributed to iron deficiency, leading to both infertility and problems in childbirth for women (Crawford 1999: 58; Howe 1997: 86; McGovern 2003: 21). Bacterial infections of foods could have been a very real hazard, especially with flies, human faeces and rodents likely to be present (Roberts & Cox 2003: 195). The inclement weather in the thirteenth and fourteenth centuries contributed to an epidemic of ergotism, caused by ingestion of rye infected by the parasitic fungus *Claviceps purpurea,* which can induce strong uterine contractions causing abortion therefore further reducing fertility (Finucane 1977: 108; Krause 1959: 169; Roberts & Cox 2003: 227).

Anglo-Saxon and Medieval Age of Marriage

The age of marriage and percentage of the population marrying is obviously important in determining fertility (Chamberlain 2006: 35; Flandrin & Southern 1979: 58; Hanawalt 1986: 172; McLaren 1990: 113). Early marriage and a high proportion of the population marrying should increase the reproductive capabilities (Chamberlain 2006: 35; Flandrin & Southern 1979: 58; Voland 1998: 352). One of the consequences of a later age of marriage for women is the lengthening of the generation gap. Children are more likely to be looked after by older and even widowed mothers whose control and management of property are greater even when they remarry (Goody 1983: 208; Herlihy 1985: 107). On the other hand, later marriage for women makes pre-marital chastity more difficult to maintain; delays in marriage lead to bridal pregnancies and to the acceptance of mantle-children, those 'covered' by the subsequent marriage of their parents (Goody 1983: 213).

The age at which Anglo-Saxon girls were married is open to debate (Crawford 1999: 111). The law codes do, however, imply that there was an age before which it was socially unacceptable for a girl to be involved in a sexual relationship. For example, Alfred's Law 29 (Attenborough 1922: 63-93; Whitelock 1979: 407-413) legislates against anyone raping an under-age woman (*ungewintredne wifman*), but frustratingly, no hint is given as to what that age was (Crawford 1999: 112). The *Anglo-Saxon Chronicle* (Garmonsway 1953) reports that in 855 the aged king Æthelwulf married the twelve-year-old daughter of Carloman from France, there is no hint that this union was thought of as remarkable or scandalous (Power 2007: 36). Presumably this was a feasible age for marriage that is perhaps supported by the archaeological evidence which indicates that girls were buried with adult female grave goods such as chatelaines and brooch sets from as early as ten or twelve years of age (Crawford 1999: 111).

Medieval children under seven-years-old could not enter into a marriage contract, and those over that age could repudiate the agreement at the age of puberty which was canonically established as fourteen for boys and twelve for girls (Hanawalt 1986: 98; Macfarlane 1993: 127; Ward 1992: 13). Few cases appeared in ecclesiastical courts arguing for dissolution of marriage contract on the grounds of the parties being too young (Hanawalt 1986: 98). This is probably either because children so young contracted few marriages or because their repudiation was accepted without a court case (Hanawalt 1986: 98). Chaucer had the Wife of Bath married first at the canonically permitted age of twelve, however it is likely that such an early age of marriage was used as a literary device to shock the public and enhance the sexuality of his character (Hanawalt 1986: 98; Herlihy 1985: 106). In his study of the 1185 survey of the wards of King Henry II the *Rotuli de dominabus*, which lists the ages of the widows and their dependent children, Herlihy (1985: 105) was able to calculate the age of the widows at the birth of their oldest child, by subtracting the age of the oldest child from the age of the mother, and from that infer an age at marriage. Herlihy's (1985: 105) study of the *Rotuli de dominabus* suggested that the average age of the women at marriage was seventeen or younger, although at least one widow must have been younger than fourteen when she married (Herlihy 1985: 105).

The age at first marriage for medieval men is even more difficult to determine than that of women, yet from about 1200 it is clear that many men were postponing marriage (Hanawalt 1986: 96; Herlihy 1985: 108). The family reconstitution study of medieval Halesowen showed a variable age of marriage depending on economic circumstances (Hanawalt 1986: 96). In the early fourteenth century, when land was hard to come by and wages were depressed, couples married in their early twenties (Hanawalt 1986: 96; Razi 1980: 63). However, when new economic opportunities opened up following the Black Death, the marriage age for women and men dipped into the late teens (Hanawalt 1986: 96; Razi 1980: 63). The London mercers before 1457 had a ten-year compulsory apprenticeship and by 1501 were refusing to enrol any apprentice under the age of sixteen (Thrupp 1948: 193). Yet, since many London merchants willed property to be delivered to their daughters at the age of thirteen or fourteen, or else upon marriage, it was apparently considered proper for girls to be married by that age (Thrupp 1948: 196). Likewise the 'country girl' wife of 26 year-old Thomas More (from a middle-class London family) was sixteen or seventeen when she married around 1504 (Herlihy 1985: 106). Interestingly Thomas would have preferred the hand of the younger sister, but the father wanted his daughters to be married in order of age (Herlihy 1985: 106).

Behind all of the restraints and regulations that surrounded the institution lay the practical principle that only couples with resources, and specifically some land, should be rearing children (Dyer 1989: 157; Voland 1998: 352). This would help to prevent a population explosion, because those without resources would remain celibate (Dyer 1989: 157; Hanawalt 1986: 96). Land shortage and low wages forced a certain number of young adults born to middling and especially to poor families to postpone their marriages, and some of them probably never married at all (Dyer 1989: 157; Goody 1983: 258; Hirschman 1994: 209; Razi 1980: 64). However, from at least the fourteenth century we see in England an active wage labour market of servant hood and apprenticeship which usually lasted ten years (Kettle 1995: 20; Macfarlane 1993: 267; Thrupp 1948: 193). In this system children kept the profits of their labour, and consequently it provided an alternative to inherited wealth and thus a relative weakness of parental control (Macfarlane 1993: 267). Evidence from the fifteenth-century wills and fourteenth-century manorial court records dispel the myth that sons waited for their fathers to retire before marrying. Instead about 38% of the sons who formed households as in the pre-plague years did so before their fathers died or retired (Hanawalt 1986: 97). This suggests that medieval children did not necessarily rely on their parents to help them set up home and nor did they seem to have felt a strong obligation to provide for their parents in old age. Rather, parents made their own arrangements, occasionally even to the extent of disinheriting their children (Goldberg 2006: 434).

The Hazards of Childbirth in Anglo-Saxon and Medieval England

High female mortality in the child bearing years is often observed and can have a dramatic affect on fertility by reducing the sexually reproductive population. An understanding of potential problems associated with pregnancy as well as the desire for the child's survival is indicated in the antenatal advice found in the ninth-century Bald's Leechbook III XXXVII: '*Earnestly must a pregnant woman be cautioned, that she eat naught salt or sweet, nor drink beer, nor eat swines flesh, nor aught fat, nor drink to drunkenness, nor fare by the way, nor ride too much on horse, lest the bairn come* *from her before the right time'* (Cockayne 1961a: 329-331), even if not all of the directions were necessarily beneficial. According to the medieval posthumous miracles, still-births were relatively common; one woman delivered a dead infant four times, another on seven occasions, while a third gave birth to triplets – all dead (Finucane 1977: 106).

If the foetus was not expelled naturally as a miscarriage or stillbirth, the outlook for the mother was bad, although the Anglo-Saxon doctor did have a range of treatments to prescribe (Crawford 1999: 61; Finucane 1977: 106; Shahar 1990: 34). Crawford (1999: 61) describes an Old English remedy, derived from Dioscorides, where the woman could be given dittany juice, either in wine or warm water, if she had a fever: *'it will expel the foetus immediately without harm'*. However, this would have probably been impractical for Anglo-Saxon women because dittany, not being native to Britain, was extremely difficult to grow and would not survive a cold winter (Crawford 1999: 61). Pennyroyal is another Mediterranean plant recommended in the ninth-century Bald's Leechbook to expel a dead foetus XCIV 7; '*if a dead-borne child be in a wifes or womans inwards, take three sprouts of this same wort, and let them be new, so do they strongest scent, pound in old wine; give to drink'* (Cockayne 1961c: 207). Pennyroyal might have been more accessible and because it is noted in modern herbals as being a uterine stimulant which should not be used during pregnancy, it might have had some chance of achieving its aims (Crawford 1999: 61).

More difficult to obtain, and useful only as a palliative, was the drink of wolf's milk mixed with wine and honey (Crawford 1999: 61) recommended in the ninth-century Bald's Leechbook Painting of a wolf IX 7; *'the woman who may have a dead bairn in the* *inwards, if she drinketh wolfs milk mingled with wine and honey in like quantities, soon it healeth'* (Cockayne 1961c: 363). If all these efforts had failed, the midwife was instructed to extract the dead foetus from the uterus with a hook with the aid of a mirror, if it could not be extracted whole she was to remove it in parts (Shahar 1990: 34). If the mother died and the foetus was still alive, it was the obligation of the midwife, according to the authors of medical works, to make an incision in the left side of the corpse with a razor and to extract the living infant (Shahar 1990: 35).

There are no figures from the Anglo-Saxon or medieval periods to indicate how many died during the delivery or immediately post-partum, but the number was undoubtedly high (Shahar 1990: 35). The demographers estimate that some 25 out of every 1,000 women died in childbirth in England in the sixteenth and seventeenth centuries, and some 200-300 out of every 1,000 infants died before the age of five (Shahar 1990: 35). Obstetric deaths can result from puerperal fever, dystocic presentation, obstructed labour due to a malformed pelvis, breach birth or an oversized foetus (e.g. as the result of diabetes), haemorrhage or premature detachment of the placenta (Lewis 2007: 34; Shahar 1990: 35). The age-at-death of Anglo-Saxon pregnant women in the archaeological record ranges from fifteen to over thirty-five, with the majority of cases occurring after the woman had passed twenty years-of-age (Crawford 1999: 110). It would be tempting to interpret this as an indication that Anglo-Saxon women delayed marriage and childbirth until after their teens, which would lead to a reduced risk of miscarriage, stillbirth or death in childbirth, but with such a small sample it would not be statistically viable to make such an assertion (Crawford 1999: 110).

Birth Control in Anglo-Saxon and Medieval Society

With childbirth being such a dangerous process it is unsurprising that some women would go to great lengths to avoid becoming pregnant even at risk of accusations of witchcraft by the misogynistic churchmen who countered that women were motivated by frivolous concerns; they were frequently accused of limiting their pregnancies merely to protect their beauty or reputation (McLaren 1990: 116). Thomas of Chobham, author of a popular thirteenth-century confessor manual, asserted that they had recourse to means to hide the evidence of illegitimate affairs and spare themselves the dangers of child birth (Biller 1982: 16; McLaren 1990: 116). Medical, legal and religious texts clearly indicate that ritual and herbal remedies were pursed by women who either wished to propagate, maintain or terminate pregnancies (Crawford 1999: 67; McLaughlin 1974: 120; Power 2007: 37). Medical treatises suggested a variety of herbs and some applied to the vagina may have acted as a block to sperm (Hanawalt 1986: 100), with the curious work attributed to Pope John XXI (1276), *The Treasury of Healthe*, alone listing twenty-six recipes for contraception (McLaren 1990: 123).

Medical texts list a variety of herbal suppositories and potions that a woman might take to induce abortion (Benton 1985: 35; Hanawalt 1986: 101). The most plausible Anglo-Saxon example comes in the *Herbarium Apuleii*: *'this plant fleabane, sodden in water, and used as a suppository by a woman purges the womb'* (Crawford 1999: 67). The fourteenth-century works of Trotula, translated into English contained a typical recipe for an abortifacient pessary of ris, savin, white wine, ivy and honey (McLaren 1990: 125). The Laws of Henry I (1106-1135) also indicate that some medieval women may have attempted to abort their unwanted children, for example Law 70, 16:

‘*Women who commit fornification and destroy their embryos, and those who are accessories with them, so that they abort the foetus from the womb, are by an ancient ordinance excommunicated from the church until death*’ a later provision 70, 16a: *‘A milder provision has now been introduced: they shall do penance for ten years’* (Downer 1972: 223).

Abortion was also a concern of ecclesiastical writers (Hanawalt 1986: 101; Lyman 1974: 93). In Burchard of Worm’s eleventh-century *Decretum,* abortion was seen as evil as killing a man, with both being punished beyond the seven-year marker (Duby 1998: 22). The fifteenth-century Canterbury Act books also contain several prosecutions for some kind of abortion (Helmholtz 1975: 380). George Hemery was charged by the judge of the Consistory court of Rochester in 1493 with placing medicines in a drink given to a woman ‘*in order to destroy the boy he had procreated’* (Helmholtz 1975: 381). The servant of Joan Gibbes of the parish of Deal (also named Joan but with no surname given in the court record) was accused in 1469 of having *‘killed the infant lately in her womb by means of herbs and medicines’* (Helmholtz 1975: 381). Only one such case appeared in the coroners’ inquests studied by Hanawalt (1986: 101) ‘*on 12 December 1503 Joan Wynspere of Batsford, ‘sinilwoman’, being pregnant, at Batsford drank divers poisoned and dangerous draughts to destroy the child in her womb, of which she immediately died. Thus she feloniously slew and poisoned herself as a suicide and also the child in her womb’.* Another possible area is constituted by those elusive indices of popular attitudes, proverbs and sayings such as the common place catch-phrase of the thirteenth century: *Si non caste tamen caute*, translated literally, ‘*If not chastely at least cautiously/ with care/ with precautions*’ (Biller 1982: 17).

The matter of formation time and ‘ensoulment’ was also of much interest to theologians (Eccles 1982: 45), particularly in regards to abortion legislation, much as it does in modern ethical discussions. An Old English copy of a text *On the Formation of a Foetus* records that by the third month of the pregnancy, the child *‘is a man without a soul’*, but by the eighth month of gestation it can be considered to be alive ‘*altogether firmly compacted’* (Cockayne 1961b: 147), and that if the ninth month comes and goes without the birth, then in the tenth month the mother will die (Crawford 1999: 61). The influence of such theological discussion can be seen in Henry the First’s (1106-1135) Law 70, 16b: *‘A woman shall do penance for three years if she intentionally brings about the loss of her embryo before forty days; if she does this after it is quick, she shall do penance for seven years as if she were a murderess’* (Downer 1972: 223). In Burchard of Worm’s eleventh-century *Decretum* he regards the abortion as less grave if the embryo was destroyed before it had *'quickened'*, before it had *'received the spirit'*, or been felt to move (Duby 1998: 13). Animation was said to occur at forty days and quickening at ninety or one hundred and twenty days (Eccles 1982: 45; McLaren 1990: 126). Abortion prior to ensoulment was certainly not considered by the Church as homicide and would not be until 1917 (McLaren 1990: 126). Abortion at any stage of gestation was no felony or misprision in fourteenth century English common law, the reasons usually cited were the difficulty of determining the time and cause of the child’s death and the fact that the child, being unbaptised had no name (Kellum 1974: 374).

The Effect of Anglo-Saxon and Medieval Sex Taboos on Fertility

The Anglo-Saxon legislation protecting the ability to produce children is suggestive of the high significance procreation held within society. Examples include Alfred the Great's (871-99) Law 65: '*If a man is so badly wounded in the genitals that he cannot have children, 80 shillings compensation'* and also Law 9: *'If anyone kills a pregnant woman, while the child is in her womb, he shall pay the full compensation for the woman, and half the compensation for the child, in accordance with the wergild of the father's kindred'* (Attenborough 1922: 63; Crawford 1999: 176; Whitelock 1979: 407). However, within the introduced Christianity doctrine, celibacy was considered the highest calling and marriage a poor second (Macfarlane 1993: 58). Nevertheless, a clear distinction was drawn between those who chose chastity within the framework of the Church, and laymen (Shahar 1990: 12). The purpose of matrimony was stated to be the procreation of children, and as such a purposefully childless marriage was considered little short of prostitution (Crawford 1999: 57; Russell 1937: 507). Clerics argued that semen was intended by 'nature' to produce children; therefore any frustration of such intent was more than a mere sin; it was a violation of natural law (McLaren 1990: 102; Shahar 1990: 71). The pastoral guides forbade their parishioners to engage in *coitus interruptus*, ranking incest with a daughter as a lesser sin than performing unnatural sex with one's wife (Hanawalt 1986: 100). Whether or not *coitus interruptus* is a self evident or a learned technique of contraception, it is clear that in the Middle Ages it was believed that some positions could either inhibit or aid conception (McLaren 1990: 119).

Conversely, the Anglo-Saxon penitentials were also astonishingly restrictive in their demands for marital continence. Such intimacy was forbidden in specific stages of the woman's physiological cycle; during menses, pregnancy, birth and nursing, and in specific stages of the liturgical cycle; three days before communion, three days after the marriage ceremony, all church festivals (which were very numerous), Sundays and the two fast days of Wednesday and Fridays, forty days during Lent and forty days before Christmas, as well as during all periods of penance (Boswell 1989: 338; McLaren 1990: 116; McLaughlin 1974: 113; Stone 1977: 498). Similarly in Cnut's (1020-1023) Law 47: '*Anyone openly commits a breach of the Lenten fast by fighting or intercourse with women…double compensations are to be paid, as on a high festival, in proportion to the deed'* (After Crawford 1999: 177; Whitelock 1979: 454-467). Whilst it is perhaps difficult to conceive these regulations being strictly and universally obeyed (Stone 1977: 498), it has been suggested by McLaren (1990: 116) as a possible contributor to the slow population growth that took place in Europe prior to the tenth century. Nevertheless, the intent of such instruction was not to limit fertility but to prevent immorality (McLaren 1990: 116).

Thirteenth-century writers hastened to keep alive fears of the dire consequences of ill-timed passions (McLaughlin 1974: 113). Robert of Flamborough warned that children conceived during menstruation, or before weaning would be lame, leprous, given to seizures, deformed, or short lived (Boswell 1989: 338; Clark 1994: 145; Given-Wilson & Curteis 1984: 38). Evidence suggests, however, that seasonal variations in conceptions were not so much a result of Christian teachings but as a response to the demands of the rural economy, with attempts made to avoid having children in the summer, when women would be hard at work in the fields (Biller 1982: 16; McLaren 1990: 117). This birth seasonality may perhaps by influenced by seasonal spousal separations caused by labour migration, although there is also evidence to suggest that birth seasonality becomes a result of seasonal energetic stress (Ellison 1994: 267). For example, research on the fertility levels of modern Polish female agricultural workers who undertake difficult seasonal manual labour, but are otherwise healthy and well-nourished, indicate that women who work longer hours have lower indices of ovarian function during the agricultural season than those who work shorter hours (Ellison 1994: 266).

Fertility and Infant Feeding Practices in Anglo-Saxon and Medieval England

Breastfeeding customs have an influence on fertility as it prolongs the period of postpartum amenorrhea and thereby postpones the resumption of ovulation following childbirth (Coale 1974: 46; Hajian-Tilaki 2002: 406; Jay 2009: 165; Mays 2003a: 731; McLaren 1990: 117; Read & LeBlanc 2003: 61; Stone 1977: 64; Weiss 1976: 359). Breast milk and breastfeeding have become intricately linked to physiological processes and health and disease patterns of both mothers and infants (Danforth 1999: 5; Huck 1995: 541; Sellen 2007: 132; Stuart-Macadam 1995: 7). Postponing the introduction of nonbreast-milk foods and liquids until at least four to six-months of age dramatically reduces an infant's risk of exposure to environmental contamination, while assuring the nutritional and immunological benefits of breast milk through this period (Dettwyler & Fishman 1992: 184; Fuller *et al.* 2006b: 49; Katzenberg *et al.* 1996: 178; Lewis 2007: 98; Scrimshaw 1978: 394). The concentration of immunoglobins is highest in colostrum but their presence is maintained throughout lactation (Katzenberg *et al.* 1996: 178; Lewis 2007: 98). The immune system of the neonate is immature so this transfer of immunological components is extremely beneficial (Fildes 1995: 117; Katzenberg *et al.* 1996: 178). There is evidence that factors in breast milk also induce the infant immune system to mature more quickly (Katzenberg *et al.* 1996: 178). Furthermore, the high-lactose, low-phosphate, and low-protein content of breast milk produces a low pH in the gastrointestinal tract that is inimical to the growth of bacteria (Fildes 1995: 118).

Anglo-Saxon and medieval mothers of lower social rank must have nursed their own children and probably most other mothers did as well (Goldberg 2006: 15; Hanawalt 1993: 57; 1986: 178; McLaren 1978: 385; Shahar 1990: 59). Authors of medical works, preachers, authors of confessors' manuals, and almost without exception, authors of secular didactic works favoured maternal nursing (Nelson 1994: 92; Shahar 1990: 55). From the hagiography we discover that the lower class mothers of future saints breast-fed their children and that many women from the labouring classes appealed to saints when their milk dried up or when the infant had difficulty in nursing (Shahar 1990: 60). The art of the fourteenth to fifteenth centuries, particularly in Italy, repeatedly depicts the Holy Mother nursing her child as the ideal image for all mothers in this world (Hanawalt 1986: 178; McLaren 1990: 105; McLaughlin 1974: 115; Shahar 1990: 56). Praising maternal breastfeeding on both scientific and emotional grounds, Bartholomeus Anglicus in the thirteenth century explained that *'while the foetus exists in the womb it is nourished on blood, but at birth nature sends that blood to the breasts to be changed into milk'* (Kellum 1974: 380; McLaughlin 1974: 115; Shahar 1990: 55).

In medieval Europe, colostrum was considered harmful due to its different colour and consistency, and was often denied the newborn child (Lewis 2002a: 9; Lewis 2007: 102). It is now clear that the denial of colostrum would have significantly reduced the life chances of the children concerned; colostrum is three times as protein-rich as mature human milk and its antibodies protect the neonate from bacterial infection (Fildes 1995: 117). It aids the evacuation of the sticky black contents (meconium) of the neonates intestine and contains several antibodies and other proteins that protect the newborn infant from bacterial infections (Fildes 1995: 117; Saunders & Hoppa 1993: 135). Instead of colostrum medieval newborns were fed butter, oil of sweet almonds, sugar, honey, syrup or wines to make them vomit (purge) and clear the mucus from their mouths and intestines (Lewis 2007: 102). Honey is now known to represent a risk factor for infant botulism, and therefore it is recommended that honey not be fed to children under twelve-months-old (Arnon 1979: 335; Koepke *et al.* 2008: 78; Nevas *et al.* 2005: 145). Further potential for infection and gastrointestinal diseases came from spoons and dishes used to feed the child, not to mention the milk fever which would have been a serious health risk for mothers who did not clear their breasts of milk, risks which could only be resolved when the child was finally put to the breast, two-to-four days after birth (Lewis 2002a: 10; Lewis 2007: 102).

There are some rare examples of feeding vessels have been found on sites and within infant graves throughout Europe (Lewis 2007: 102). The infant from Grave 133 at the Anglo-Saxon site Castledyke South, Barton-on-Humber was buried with a mammiform pot that has been interpreted as a feeding bottle, measuring 11.1cm high with a rim diameter of 63.7cm (Crawford 1999: 95; Didsbury 1998: 310; Wileman 2005: 140). Nursing-horns consisting of a small cow's horn with a small hole pierced at the end with a kind of two-fingered glove of parchment attached through which the infant drank, are seen in illustrations from medieval France, Holland, and Winchester Cathedral, and described in a twelfth-century poem where they were listed as standard equipment of the nurse (Hooper 1996: 231; McLaughlin 1974: 117; Shahar 1990: 54). These feeding vessels suggest that not all infants were exclusively breastfed during their first year of life although it is not possible to tell if these vessels represent supplementary or artificial feeding (Crawford 1999: 95; Lewis 2007: 102). The use of such a feeding bottle, with the attendant possibility of infection or contamination in the milk, would have dramatically decreased an infant's chances of survival (Crawford 1999: 95).

Wetnursing in Anglo-Saxon and Medieval England

Given the potential problems with artificial feeding of infants, both in terms of sterilisation and nutrition, it is unsurprising that wetnurses were employed when a mother struggled to breastfeed her child, a task made even more difficult with multiple births, or if the mother died in childbirth (Shahar 1990: 69). Hanawalt (1986: 179) describes the tragic fourteenth-century case of Johanna, the six-month-old daughter of John of Burgoyne, put out to nurse after the death of her mother, who then died in a cradle fire when her nurse, Beatrice Paysele, went off to church with a neighbour. Even some of the most moralistic authors saw the necessity of wetnurses in some situations, for example, although in the thirteenth century Thomas Chobham defined the refusal to breast-feed as murder he concluded by adding *'if the mother cannot carry the whole burden alone, she should nurse and bathe her infant at least when she is able, and thus will not be like one who acts unnaturally and never goes near her child'* (Shahar 1990: 57).

There is evidence that some of the Anglo-Saxon élite used wet-nurses as *childfestran*, literally the nourisher of the child, is specifically mentioned in Ine's (-726)

Law 63 as one of the necessary members of a thane's personal retinue: *'If a thane travels, he may take with him his reeve, his smith and his children's nurse'* (Crawford 1999: 70). Furthermore, in his response to St Augustine's eighth question, Pope Gregory stated that *"a man should not approach his wife until her child is weaned. But a bad custom has arisen in the behaviour of married people that women disdain to suckle their own children, and hand them over to other women to nurse. This custom seems to have arisen solely through incontinency; for when women are unwilling to be continent, they refuse to suckle their children"* (Goody 1983: 37; Latham & Sherley-Price 1968: 78). The passage, recorded by Bede in the eighth century, brings out an interesting relation between the use of wetnurses and the avoidance of the *post-partum* prohibition on sex (Goody 1983: 37). Crawford (1999: 70) speculates that as Pope Gregory's local knowledge may have been limited – his complaint was more likely to have been a comment on Roman practices.

From the eleventh century onwards, wetnurses became fashionable among the wealthy, with children being nursed in the home or kept nearby (Lewis 2002a: 10). Prosperous town-dwellers sometimes employed wetnurses in their homes, for example Thomas Becket, son of a twelfth-century merchant from Rouen who settled in London, apparently also had a live-in wetnurse (Shahar 1990: 61). Other parents put their infants out to nurse with wetnurses from rural areas who took children into their homes receiving the lowest wage, sometimes only half as much as the live-in wetnurse (Shahar 1990: 61). According to Gerald of Wales, the wives and concubines of English parish priests at the end of the twelfth century also called on the services of wetnurses: denoting these priests, he writes that they did not observe the rule of celibacy as should all the clergy, and that their miserable homes were *'cluttered up* *with small infants, cradles, midwives, and nurses'* (Shahar 1990: 62). The thirteenth-century synods caution mothers and wetnurses against sharing a bed with an infant for danger of smothering (Shahar 1990: 63).

One of reasons promoted for the sending of new-born infants out to mercenary wet-nurses is that it made the appalling level of infant mortality much easier to bear, however, the death rate of infants fed by hired wet-nurses seems to have been about twice that of infants fed by their mothers (Lewis 2002a: 10; McLaren 1978: 387; Stone 1977: 107; vom Saal 1994: 45). In 1401 the rolls of the manorial court of Havering record the claim of a tanner against a burgher of Romford, the small town adjacent to the manor where the tanner demanded payment of twenty-two-pence for the cost of burial of the burgher's son, who had been wetnursed by the tanner's wife (Shahar 1990: 63). Between 1578 and 1601 the register from Chesham, Buckinghamshire, lists the burials of thirty-seven nursed infants (McLaren 1979: 431). Given that the association between high infant mortality and wetnursing must have been generally known at the time, it is not unreasonable to consider a practice which had a high probability of leading to the death of an infant as being a form of socially sanctioned infanticide rather than temporary abandonment (Stone 1977: 81; vom Saal 1994: 45).

There was no way of telling how a wetnurse, or her husband and own children, would treat her charge, how much empathy she felt for it, and how she divided her milk and her attention between her charge and her own child (Shahar 1990: 67). This is especially poignant as it was certainly not their motherliness which impelled wetnurses to take in children for nursing, but their desire and that of their husbands to earn extra money (Shahar 1990: 67). There are later cases of neglect by the wetnurse: Freke's

(1641-1714) father wrote to her about *'my son being crippled by the Carlessnes of his Nurse and Aboutt 14 of December brok his Legg shortt In the Hackle Bone [hip], which she kept pryvatte for neer a quarter of A yeare Til a Jelley was Grown between Itt; She keeping him in his Cradle, & everybody believed he was Breeding of his Teeth'* (Pollock 1993: 217). Once this was discovered the child was removed to another nurse, his bone reset and he recovered completely (Pollock 1993: 217).

There may possibly also have been semi-institutionalised networks of infanticidal wetnurses, although it is difficult to distinguish neglect from deliberate killing (Adair 1996: 44). A case occurred in Malpas (Cheshire) in December 1602 where the burial occurred of a child: '*which one Jane Conwaye bore in Denbigh, carried about which child she said was given unto her in Bendlye 6 December and the said Jane was carried before a justice of Peace by Wm Golborne Constable of Malepas because she was thought to have starved the saide child and famished it to death'* (Adair 1996: 45). Equally horrifying was a well documented case from St Botolph Aldgate (London) in which a boy kept by Margaret Howse died, and the coroner's inquest revealed that he had been systematically neglected, and had died half-starved and lice ridden (Adair 1996: 45).

Even when a wetnurse was employed, however, it did not necessarily mean that the infant was neglected by its parents. For example, when lightning struck the family castle of Thomas Aquinas his mother hastened to the room where he was sleeping with his wetnurse to see if harm had befallen him (Shahar 1990: 64). The sixteenth- and seventeenth-century texts studied by Pollock (1993: 216) indicate that even infants sent to a wet-nurse were not necessarily ignored by their parents, rather frequent visits were made, particularly if the child was ill. Dee (1527-1608) visited his infants at nurse and removed one daughter who was not thriving and Wallington (1598-1658) sent his son to nurse in the country and was kept informed of his progress (Pollock 1993: 217). The very fact that the authors of didactic works advise parents to visit their children regularly, and to check the health of the wetnurse frequently, indicates that not all parents troubled to do this (Shahar 1990: 66).

It is known that breast-feeding does lengthen the interbirth interval, although this is dependent on whether the infant is exclusively breast-fed and on suckling frequency and duration (Harkness & Super 1987: 66; Higgins 1989: 182; Kaplan 1996: 93; Katzenberg *et al.* 1996: 178; Schurr & Powell 2005: 279). Prolonging the period of lactation by accepting a nurse-child and suckling it not on schedule but on demand, the lactating woman effectively minimizes her chances of conceiving again soon, while adding to her household income (Flandrin & Southern 1979: 58; Paster 1993: 201; vom Saal 1994: 55). Since the wealthy mothers did not breast feed, they lacked the (temporary and unreliable) means of birth-control at the disposal of women who nursed their own children and who conceived less frequently (Flandrin & Southern 1979: 58; McLaren 1979: 427; Shahar 1990: 70). As a consequence, among the women in the prosperous urban class and the nobility who entrusted their children to wetnurses, some gave birth to their fullest biological capacity: 10, 17, and even 19 children (Shahar 1990: 70). The medieval writers universally agreed that the infant should be fed on demand and not according to a rigid schedule (Shahar 1990: 78). However, Hanawalt's (1986: 178) study of medieval accidents suggests that peasant babies were probably not fed on demand, since they were left alone much of the time, and children were nursed for two or three years, although baby girls might have been weaned sooner.

Anglo-Saxon and Medieval Weaning Practices

Early childhood nutrition can have long-term effects on the health of individuals (Stuart-Macadam 1995: 7). Whether a child is breastfed at all and the frequency and duration of feedings may depend on the mother's attachment to the child and on her involvement with the child (Scrimshaw 1978: 394). To reduce the risk of morbidity children should continue to be breastfed, while receiving appropriate and adequate uncontaminated complementary foods, until two years of age or beyond (Dettwyler & Fishman 1992: 176; Fildes 1995: 115; Sellen 2007: 132). The immunological advantage enjoyed by breastfed infants lasts not only for the first year of breastfeeding but on into subsequent years and even continues after weaning (Stuart-Macadam 1995: 18). However, the immunological benefits of nursing do not necessarily protect the infant from environmental pathogens once infants are no longer nursing exclusively (Katzenberg *et al.* 1996: 191).

The introduction of solid foods or the weaning process is often linked to an increased risk of infant mortality and morbidity (Fildes 1995: 101; Fuller *et al.* 2006b: 49). Reduced breast milk consumption decreases the level of immunity for infants, and the weaning diet has the potential to expose children to new pathogens and nutritional stress (Blakey *et al.* 1994: 373; Fildes 1995: 120; Fuller *et al.* 2006b: 49; Saunders & Hoppa 1993: 135; Stuart-Macadam 1995: 21; Wiley & Pike 1998: 322). With respect to nursing, women should be particularly sensitive to the digestive behaviour of infants and to the impacts of supplemental foods on their digestion and diarrheal disease (Harkness & Super 1987: 66; Kaplan 1996: 109; Redfern 2003: 162). Cultural norms are likely to proscribe the introduction of supplemental foods to newborns in most contexts, and to specify which foods are the best early supplements (Kaplan 1996: 110).

The weaning period is considered to be the moment of the highest metabolic stress in early childhood, especially in pre-industrial societies and in societies with a low socio-economic level (Katzenberg *et al.* 1996: 177; Moggi-Cecchi *et al.* 1994: 300; Wiley & Pike 1998: 322). The process of weaning is often associated with elevated risks of infant mortality and morbidity because reduced breast milk consumption decreases the level of passive immunity for infants (Fildes 1995: 101; Fuller *et al.* 2006a: 289; Katzenberg *et al.* 1996: 177). The weaning diet therefore has the potential to expose children to new pathogens and nutritional stress, particularly when weaning foods are inappropriate or contaminated foods are provided (Blakey *et al.* 1994: 373; Fildes 1995: 120; Fuller *et al.* 2006b: 49; Saunders & Hoppa 1993: 135; Wiley & Pike 1998: 322).

The transition from a breast-fed to a mixed food diet, if it occurs too early in the infant's life, tends to be associated with increased risks of the weanling diarrhoea syndrome and food allergies (Herring *et al.* 1998: 427; Kaplan 1996: 109; Schurr & Powell 2005: 279; Wiley & Pike 1998: 322). The infant's immature digestive and immune systems are forced to cope with food-borne and other pathogens, while the infant simultaneously risks malnutrition as maternal milk production falls off in association with fewer and less intense nursing bouts (Herring *et al.* 1998: 427; Katzenberg *et al.* 1996: 191; Moggi-Cecchi *et al.* 1994: 303). If nutrition is inadequate there is an increase in infection rate through lowered resistance, malnutrition is further exacerbated by the infectious disease which reduces the efficiency of nutrient absorption (Danforth 1999: 5; Lallo & Rose 1979: 324; Rose *et al.* 1985: 291; Roth 1992; Saunders & Hoppa 1993: 134). Even in developing and developed countries today the risk of dying in the first year is greatest from infectious and other parasitic diseases (Margerison & Knüsel 2002: 140; Saunders & Hoppa 1993: 134); it is therefore possible they were also prevalent in the past (Saunders & Barrans 1999: 199). However, if exclusive breast-feeding continues for too long children will suffer calorie insufficiency and vitamin deficiency (Jay 2009: 165; Katzenberg *et al.* 1996: 180; Saunders & Hoppa 1993: 134; Saunders & Barrans 1999: 184). This can lead to under nutrition, developmental delays and growth retardation, due to the rapid growth of the brain within the first three years (Bogin 1997: 76; Ryan 1997: 25).

In human societies the age at weaning varies greatly (Bogin 1997: 75) and it is very possible that differences in timing of weaning could have had a recognised impact of the health and disease patterns of infants in different times and cultures (Fildes 1995: 116). Like all aspects of infant feeding, the introduction of solid food to the infant's diet is not only affected by biological factors but is also heavily influenced by cultural beliefs, the environment, and the culture's cuisine (Dettwyler 1995: 44; Dettwyler & Fishman 1992: 191; Fildes 1995: 11; Kaplan 1996: 110; Katzenberg *et al.* 1996: 193; Schurr 1998: 339). In most cultures solid foods are added to the infant's diet gradually from about six months or the age at which teeth first start to appear (Dettwyler 1995: 44; Fildes 1995: 120; Schurr & Powell 2005: 279). Postponing the introduction of non-breast-milk foods until at least four to six months of age dramatically reduces infants' risk of exposure to environmental contamination while assuring the nutritional and immunological benefits of breast milk through this period (Dettwyler & Fishman 1992: 184; Fuller *et al.* 2006b: 49; Katzenberg *et al.* 1996: 178).

What little can be discovered about the time of weaning in Anglo-Saxon and medieval society suggest a variability between one and three years and, perhaps, a shorter nursing period for girls and for the children of peasants (Crawford 1999: 73; McLaughlin 1974: 116; Shahar 1990: 79). Anglo-Saxon texts suggest a quick weaning process with Ælfric in the tenth century assuming that children would go straight from breast milk to bread (Crawford 1999: 71). The baker in Ælfric's tenth-century *Colloquy* stressed that his produce was important to 'little children', this bread was likely to have been a soft, finely ground white bread, and was considered strengthening food, both for children and invalids (Crawford 1999: 71). The *Life of St Anselm*, the eleventh-twelfth-century Archbishop of Canterbury, includes a reference by the saint to children being encouraged to wean by the method of smearing something sharp and bitter on the mother's breasts, though this reference may have more to do with Italian and Norman childrearing practices than Anglo-Saxon ones (Crawford 1999: 73).

The medieval texts illustrate that, for the majority of infants, weaning was a gradual process (Pollock 1993: 219; Shahar 1990: 79). Among all classes breast-feeding was often and quite early supplemented with 'pap' (flour and bread cooked in water) and 'panada' (flour or cereal in a broth with butter or milk) (Lewis 2002a: 10; Lewis 2007: 102; McLaughlin 1974: 116). The breast milk usually supplies zinc, an essential requirement for normal growth (Bates & Tsuchiya 1990: 61; Dórea 2002: 85; Van der Elst *et al.* 1986: 114), however, its absorption by the body was probably hindered by the high cereal content of the pap (Lewis 2002a: 10). In addition, there was a potential for contamination of the spoon and bowl used for feeding (Lewis 2002a: 10).

Stable isotope analysis of the collagen retained in bones, is often used to reconstruct breastfeeding and weaning patterns in archaeological populations (Fuller *et al.* 2006a: 279; Roberts & Manchester 2005: 225; Schurr 1998: 329; Schurr & Powell 2005: 279). Nitrogen-15 values can be used to track the duration of breast milk consumption and Carbon-13 values can be used as a possible indicator for the introduction of solid foods to the diet (Dupras *et al.* 2001: 210; Fuller *et al.* 2006a: 289; Fuller *et al.* 2006b: 47). Breastfeeding infants have a diet unusually high in nitrogen-15 compared to the rest of the population, with the reduction in nitrogen-15 through childhood indicating the replacement of breastfeeding with other foods (Dupras *et al.* 2001: 205; Fuller *et al.* 2006a: 280; Fuller *et al.* 2006b: 46; Herring *et al.* 1998: 434; Katzenberg *et al.* 1996: 188; Roberts & Manchester 2005: 225; Schurr & Powell 2005: 280).

Stable carbon and nitrogen isotope ratios from the early Anglo-Saxon cemetery of Queenford Farm, Dorchester-on-Thames, Oxfordshire, indicate a gradual weaning process starting at one-and-a-half years, with the majority of children seeming to have been fully weaned between three and four years (Fuller *et al.* 2006b: 48). A study by Macpherson (2006) of Anglo-Saxon weaning practices from later sites indicated a much faster process. The children buried in the seventh-to twelfth-century Black Gate cemetery in Newcastle were breastfed until they were approximately nine-months-old, and then weaned over the course of a few months until they were approximately one-year-old (Macpherson 2006: 163). The eighth-to twelfth-century sample of children from North Lincolnshire (from four sites; St Peter's Barton-on-Humber, Church Lane

Whitton, Fillingham and Kilton Hill) were breastfed for a longer period, with the children unlikely to be fully weaned until sometime before their second birthday (Macpherson 2006: 161), but this is still much shorter than the pattern recorded at fourth to sixth-century Queenford Farm. The stable isotope investigation on material from tenth-to sixteenth-century Wharram Percy suggested a cessation of breastfeeding between one and two years (Mays 2003a: 739).

Until the invention of pasteurisation, the prospects for survival of an infant nurtured on the milk of cows, goats or sheep were slim (Shahar 1990: 53). Cow's milk produced in rural and urban dairies was associated with the spread of tuberculosis, scarlet fever and cholera (Atkins 1992: 216; Lewis 2002a: 10). The authors of didactic literature cautioned both mothers and wetnurses against feeding infants on animal milk (Shahar 1990: 53); however, necessity must not infrequently have demanded recourse to it (McLaughlin 1974: 117). Since, like some of the ancient philosophers, medieval authors believed that milk had similar qualities to sperm and influenced the moulding of the personality, they cautioned women against the dangers to both the physical and the spiritual development of the infant inherent in a diet based on the milk of cows, sheep, or goats (Shahar 1990: 53). Thomas Chobham, in his thirteenth-century confessors' manual, writes that pagans used to feed their infants on the milk of wild animals in order to instil in them something of their savagery (Shahar 1990: 53). The very fact that the warning had to be issued indicates that the authors had encountered the practice (Shahar 1990: 54). Indeed in the epics of the period one of the recurrent motifs is the miraculous appearance of a goat, hind, or unicorn whose milk is used to feed an infant when no woman is available to breast-feed it (Shahar 1990: 54).

Population and Family Structure in Anglo-Saxon and Medieval England

It is widely believed that Britain saw a steep decline in population in the years following the end of the Roman administration, though meaningful quantification is impossible and the causes remain a matter of speculation (Booth *et al.* 2007: 171; Cunliffe 1993: 296; Drewett *et al.* 1988: 266). According to the historian Gildas (c.500-570), pestilence struck the country in the first half of the fifth century (Drewett *et al.* 1988: 266), and Bede mentions plagues and famine on several occasions with reference to the seventh century (Pryor 2006: 22). For example, Bede describes a famine in Sussex in the 670s which was so severe *'It is said that frequently forty or fifty emaciated and starving people would go to a precipice, or to the sea, where they would join hands and leap in, to die by the fall or by drowning'* rather than starve any longer *(Historia Ecclesiastica* IV: 13) (Campbell 1986: 137; Wilson 1992: 35).

By the year 1000 the population of Western Europe had approximately doubled over its seventh-century low with population estimates for England at this time varying between 1.5 million and 2.5 million (Booth *et al.* 2007: 173; Boswell 1989: 269; Howe 1997: 76; Russell 1937: 504), with about 10% living in towns (Roberts & Cox 2003: 219). Anglo-Saxon society may be visualized as a typical subsistence peasant society with the family as the unit of production and land holding (Drewett *et al.* 1988: 273). The documentary sources for Anglo-Saxon England indicate that the focus of the Anglo-Saxon family was the nuclear grouping of parents and children (Arnold 1988: 177; Crawford 1999: 10; Drewett *et al.* 1988: 273). This is suggested by the lack of specific terms in Old English for more distant relatives, and by the wills, where the inheritors were usually widows or children, and the law codes, where *wergild* or compensation was payable only to close relatives (Crawford 1999: 10). Nevertheless, Anglo-Saxon poetry suggests that emotional identification with kin was very close, with both *The Wanderer* and *The Seafarer* suggesting what a desperate plight it was to be without family or kin (Arnold 1988: 177; Crawford 1999: xii).

There was a population explosion between the eleventh and the early fourteenth centuries, the population of England increased from something like one million to eight million (Boswell 1989: 269; Dyer 1989: 155; McLaren 1990: 128; Roberts & Cox 2003: 227). The rapid population increase led to soil exhaustion from land shortage and subsequently food shortages with the famine of 1315-18 hitting an already vulnerable rural population, causing an estimated 10-15% mortality rate (Roberts & Cox 2003: 226). This was followed by the Black Death of 1348-9, which is believed to have killed about 50% of the population, thus, within two generations the population of Britain may have declined by as much as 65% (McLaren 1990: 101; Pryor 2006: 22). The two main surveys that enumerate medieval household occupants, the Domesday Book and the late-fourteenth-century poll taxes, indicate that simple families prevailed (Hanawalt 1986: 92). This is supported by the manorial records which show households containing only the immediate family, rarely comprising of more than two generations with extended families being a rarity (Hanawalt 1986: 92; McLaren 1990: 107; Roberts & Cox 2003: 225). Due to the lack of earlier records, it is not clear whether the small family size is a continuation of the Anglo-Saxon nuclear family or a consequence of lower fertility in a period of high mortality.

Generally speaking, poorer households were smaller due to a combination of lower fertility and higher mortality compared with their wealthier counterparts (Hanawalt 1986: 95; Roberts & Cox 2003: 225). At Halesowen in Worcestershire in the late-thirteenth and early fourteenth centuries, the wealthier peasants had large families, with a mean of 5.1 children in each household, compared with the cottagers' 1.8 offspring (Dyer 1989: 158; Shahar 1990: 121). The Bedfordshire coroners' rolls show that the late thirteenth-century rural household was far from being a static unit; of twenty-five cases, just over half were nuclear families from one to four children (Hanawalt 1977: 5). The fourteenth-century London and Oxford rolls speak more frankly about transitional relationships with concubines, and the nuclear families which do appear were limited to a husband, wife, and one child (Hanawalt 1977: 6). The 'average' peasant family therefore contained parents and two or three children, with a tendency for more families to have three or more offspring during the thirteenth century (Dyer 1989: 158).

Various suggestions and hypotheses have been put forward to explain the small family size including birth control, infanticide, high infant mortality, late marriages, infertility due to poor diet, high female mortality, and economic limitations on nuptiality (Hanawalt 1986: 95; McLaren 1990: 113). For those who did marry, short life expectancy combined with late age of marriage resulted in unions lasting only about fifteen to seventeen years and consequently low reproductive capacity (McLaren 1990: 113). One advantage of having a large family, particularly sons, is political; in situations where public order is fragile, then the more weapon-bearing kin a man has, the better (Oliverio 1994: 111). However, by the medieval period in England, political life was structured on other principles than the family, and hence political influence either at village or national level was not related to the number of children one had (Macfarlane 1993: 59). Sons do not seem to have been particularly desired for their fighting prowess, or daughters for the alliances they would bring (Macfarlane 1993: 59).

The dramatic reduction of population in many parts of Britain caused a scarcity of labour and for a time art, education, trade and industry were paralysed by the devastating effects of the plague, high wages also contributed to a change-over from arable to sheep farming and in some cases to abandonment of villages (Howe 1997: 95). Furthermore, the increased concentration of landed property was accompanied by the creation of large agricultural holdings and the proletarianization of the smaller peasants, so that the poor, lacking the means to support their children, at least beyond a certain age, sent them to work in the houses of the rich as domestic servants (Flandrin & Southern 1979: 59). Around 1500 the anonymous secretary to Francesco Capello, Venetian ambassador to England, recorded the earliest extant Venetian account of the country (Delany 1994: 18). The young Italian deplored '*the want of affection in the English manifested towards their children; for at the age of seven or nine years at the utmost, they put them out, both males and females, to hard service in the houses of other people'* (Delany 1994: 18; Stone 1977: 107). Nobles and gentry did send their children out to noble homes to learn manners and a career; for example Chaucer was a page in the household of Lionel, Duke of Clarence (Delany 1994: 18). While bourgeois and artisan families often sent theirs out to apprentice in a trade; generally the children did not return home after their training but went on to work and marry (Delany 1994: 18).

Conclusion: Anglo-Saxon and Medieval Fertility

This chapter reviewed the many factors that would facilitate and inhibit fertility in Anglo-Saxon and medieval England. This was explored because fertility patterns have a direct impact on mortality rates, and they also affect the demands on family resources and consequently influence the use of family limitation techniques including infanticide. There are few reliable Anglo-Saxon and medieval sources quantifying population size in England, though estimations suggest that this fluctuated from a famine induced low in the seventh century rising to a high of eight million by the early fourteenth century. It is interesting to note that despite the constant impact of Malthusian checks such famine and disease, some medieval women still felt the need to go to great lengths to avoid becoming pregnant and to rid themselves of unwanted progeny through the dangerous use of unlicensed abortifacients. Whilst we cannot be sure if this was actually an effort to control family size or instead to prevent the birth of an illicit child, it is interesting to observe that the poorer medieval families were reported to having fewer children than their wealthy counterparts. It should, though, be recognised that poorer women were less likely to have had an adequate diet, and so the detrimental effects that insufficient nutrition and parasitic attack have on fertility would have had a greater impact on those families with fewer resources.

Breastfeeding customs have an influence health and disease patterns of both mothers and infants and directly affects fertility as it prolongs the period of postpartum amenorrhea and thereby postpones the resumption of ovulation following childbirth. Most Anglo-Saxon and medieval authors favoured maternal nursing, though the denial of colostrum proposed by some medieval writers would have placed neonates at risk of infection and gastrointestinal diseases, perhaps even increasing mortality at this already vulnerable age. There are some examples that suggest that the Anglo-Saxon élite and the prosperous medieval town dwellers chose to use wet-nurses in favour of maternal feeding. This will have increased their own levels of fertility since they lacked the means of birth-control presented by breastfeeding. There is some suggestion that medieval parents chose to send their children away to be wetnursed to distance themselves from children during a time of high mortality, though it was also shown that a wetnursed child was at greater risk of mortality than those kept at home.

It is important for osteoarchaeologists to understand that the weaning period is considered to be the moment of the highest metabolic stress in early childhood. The variation in the age of commencement and completion weaning recognised to impact on the health and disease patterns of infants in different cultures. What little can be discovered about the time of weaning in Anglo-Saxon and medieval society suggest a variability between one and three years. The Anglo-Saxon texts suggest a quick weaning process whereas the medieval documents indicate that weaning was a gradual process for the majority of infants, with these reported patterns supported by some of the stable isotope research. The impact of the weaning period on infant mortality will, therefore, need to be considered in the discussion and interpretation of the osteoarchaeological results presented in Chapter 11.

Chapter 7

Children in Anglo-Saxon and Medieval Funerary Contexts

Introduction

The preceding chapters discussed patterns of mortality and fertility so as to contextualise the osteoarchaeological research presented later in this thesis, and reviewed the Anglo-Saxon and medieval social values to provide basis for the discussion and interpretation of the results in Chapter 11. Nevertheless, this analysis of infanticide in Anglo-Saxon and medieval England involves the examination of infants and children from the archaeological record. It is therefore also necessary to discuss the funerary contexts from which Anglo-Saxon and medieval children are recovered. It is important to explore the deviant funerary practices, as well as the normative customs, because infanticide is often a secretive act that requires the abnormal disposal of the victim (Emmison 1970: 157; Gowing 1997: 109; Meindl & Russell 1998: 377).

When studying archaeological skeletal populations, however, it is extremely important to remember that it is unknown how far the remains constitute a representative sample of the population of which they formed a part (Brothwell 1972: 75; Ubelaker 1999: 135; Waldron 2001: 46). It is essential that the osteoarchaeologist is aware of the preservation and recovery issues that may bias the composition of the archaeological population. This chapter, therefore, starts with a discussion of the factors that could cause an osteoarchaeological sample to be under-representative of the population, paying particular attention to the differential skeletal preservation, archaeological recovery and cultural deposition of juvenile remains. The osteoarchaeological evidence for Anglo-Saxon and medieval funerary practices of juveniles is then reviewed, comparing the recovery rates of subadults from the earlier pagan burial grounds to those from later Christian cemeteries. This discusses the possible influencing factors and analyses the effect that they have had on the recovery rate of juveniles from Anglo-Saxon and Medieval contexts. These factors include; grave positioning, grave clustering, grave depth, deviant burial practices, the impact of cremation during the pagan period, the burial taboos regarding unbaptised infants in medieval England, and the influence of archaeological research objectives.

Representation of Children within the Archaeological Record

There are many factors that conspire to render osteological samples incomplete and under-representative of the population including differential preservation, recovery and deposition of skeletal remains (Buikstra & Ubelaker 1994: 39; Chamberlain 2000b: 102; Chamberlain 2006: 4; Larsen 1997: 335; White & Folken 1999: 437). It is unlikely that the number of skeletons in an assemblage will approximate to the total number of the population who lived or died in the vicinity of the burial place (Canon 1995: 3; Hoppa & Fitzgerald 1999: 14; Waldron 1994a: 12). Indeed, it is a common observation with archaeological skeletal populations that the number of juveniles is often lower than might be expected for a particular time and place (Baxter 2008: 162; Becker 1995: 24; Booth *et al.* 2007: 173; Brothwell 1972: 83; Chamberlain 1997: 249; Hoppa 2002: 16; Parker-Pearson 2002: 103; Saunders & Barrans 1999: 184; Sofaer Derevenski 1994: 8).

Bone preservation is influenced by both intrinsic and extrinsic factors (Bello & Andrews 2006: 1; Boddington *et al.* 1987: 4; Buckberry 2000: 2; Henderson 1987: 44;

Millard 2001: 637). Intrinsic factors include the chemistry, size, shape, density, porosity and age of the bone, whereas extrinsic factors such as groundwater chemistry, clothing, soil type, temperature, oxygen levels, flora and fauna all play a role in diagenesis (Bell *et al.* 1996; Buckberry 2000: 2; Henderson 1987: 44; Lewis 2007: 24; Millard 2001: 637). Soil chemistry is believed to be the most influential extrinsic factor in bone diagenesis, with preservation generally better in soils with a neutral or slightly alkaline pH, whereas acidic, free draining soils such as sand and/or gravel result in poor archaeological preservation of bone (Bethell & Carver 1987: 13; Henderson 1987: 46). However, in the study by Gordon and Buikstra (1981: 569), the pH alone only accounted for 23% of the differential preservation in the immature bone sample examined. The residual variation was thought to be the result of the large range of bone densities expressed in the age interval (Gordon & Buikstra 1981: 569; Guy *et al.* 1997: 225; Walker *et al.* 1988: 183). Bone mineral density is considered to be the most significant of all the intrinsic factors (Buckberry 2000: 2), and is affected by the age, sex and health of the individual (Boddington *et al.* 1987: 4). It is widely believed that because the bones of infants and children are small and fragile, and have a higher organic and lower mineral content than adult bones, they are more susceptible to decay (Boddington 1987c: 181; Jackes 1992: 206; Paine & Boldsen 2002: 169; Walker 1995: 41). It has, however, been observed that skeletons of perinatal age often survive relatively well; they are frequently preserved better than those of older children (Mays 1993: 886; Molleson 1989: 34). Some have argued that the high collagen content of perinatal infant bones compensates for any lack of calcium (Sundrick 1978: 232). More recently it has been suggested that infants who die before their first feed will decompose at a slower rate than a fed infant, due to the lack of organisms in the stomach, intestines and lungs (Bell *et al.* 1996: 137; Lewis 2007: 24).

A further consideration in the representation of children from the archaeological record is the rate of recovery, which can be reduced by deficiencies of skill on behalf of the excavators, with the failure to recognise small, unfused parts of the immature skeleton (Boddington 1987c: 181; Gowland & Knüsel 2006: x; Paine & Boldsen 2002: 169; Pinhasi & Bourbou 2008: 40; Waldron 2001: 45). It remains unknown to what extent this pattern is due to the failure of excavators to recognise smaller bones, rather than actual bone survival (Buckberry 2000: 2). Whilst it seems reasonable that juvenile skeletons may be somewhat incomplete, it seems unlikely that entire skeletons could be completely missed by excavators (Buckberry 2000: 2; Duhig 2003: 96).

It is clear, however, that juvenile burials were given a lower priority in earlier excavations, as their skeletons were considered to yield little useful information for the osteologist. Earlier archaeologists had a tendency to ignore subadult skeletons, often only noting those newborns that were buried with their mothers (either still *in utero* or placed beside their mother in the grave) (Booth *et al.* 2007: 173; Buckberry 2000: 4; Kjølbye-Biddle 1992: 241). Kjølbye-Biddle (1992: 241) cites a note written in 1965 by Rosemary Powers of the British Museum Natural History team which states that the team was not saving immature bones from the Winchester Minster excavations at that stage in the 1965 season. It is therefore probable that there was not a full study of the child bones in the earlier years of the Winchester Minster excavations (1962-5) (Kjølbye-Biddle 1992: 241). Unfortunately it is unlikely that this is an isolated example.

The archaeological recovery can be complicated by the fact that subadults are often described as having been buried shallowly, and as such are thought to be more vulnerable to taphonomic processes and grave disturbance (Boddington 1996: 27; Booth *et al.* 2007: 173; Boylston & Roberts 1996: 175; Crawford 1991: 21; Dawes & Magilton 1980: 11; Down & Welch 1990: 184; Lee 1994: 67). A child's body can become skeletonised in just six days compared to several weeks for adult remains (Lewis 2007: 23; Morton & Lord 2006: 479), therefore, children's bodies can become disarticulated more easily and are more susceptible to scavenging and dispersal as their small size makes it easier for animals to move them around (Buckberry 2000: 2; Henderson 1987: 44). The presence of infant bones in many disarticulated and disturbed contexts would strongly support this as at least a partial explanation (Dawes 1980: 27). This process may seriously affect the level of bone preservation for a site, however, it seems unlikely that such disturbance could cause an entire juvenile skeleton to be lost (Buckberry 2000: 2). Unfortunately, few archaeological excavations consider grave depth or length in their analyses (Lewis 2007: 186). The shallow burial of children can be indicative of differential treatment (Crawford 1991: 22; Scott 1999: 109), and may imply the social attitudes to the deceased, such as the possible low regard in which the dead must have been held by the communities burying them (Lucy 1994: 27). Rarely discussed, however, are the practical problems of digging a small yet deep grave that may necessitate the shallow burial of the smaller members of society (Lucy 1994: 27).

A further explanation for the under representation of subadults is that they are frequently buried away from cemeteries, in house floors, entryways or in other domestic contexts (Becker 1995: 25; Saunders 1992: 2; Scheuer & Black 2000: 11), therefore possibly remaining undiscovered and unrecovered by archaeological excavation (Scott 1999: 107). The apparent exclusion of subadults, particularly neonates, from formal, collective, ritual space is not an isolated phenomenon of one region at one time (Lucy 1994: 27; Stini 1985: 191), rather there is a tendency for infants, more than any other demographic group, to be excluded from communal burial grounds (Baxter 2005: 103; Donnelly & Murphy 2008: 213; Jackes 1992: 214; Saunders & Hoppa 1993: 129; Ucko 1969: 271). Therefore, it is recognised that differential burial rites are likely to be the main cause of under representation of subadult remains from archaeological populations (Brothwell 1981: 67; Lewis 2000: 41). Patterning of graves within communal cemeteries, where children are clustered in specific sections of the graveyard for practical or ritual reasons, will also limit their recovery if the entire cemetery is not excavated (Lewis 2007: 186).

When using data from cemetery samples it is particularly important to remember that we are actually measuring burial rates rather than mortality rates (Lewis 2000: 40), as all such samples are biased by cultural factors (Arnold 1980: 106; Buikstra & Mielke 1985: 366; O'Shea 1984: 34; Williams 1999: 96). The manner of disposing of the dead is not socially peripheral or irrelevant but part of the fabric of social existence (Scott 1991: 117), reflecting social or cultural norms and ideals (Brothwell 1972: 75; Finucane 1981: 41), and economic conditions (Scheuer & Black 2000b: 10). As the dead cannot bury themselves, archaeologists deal with the social perceptions of the deceased by others (Lucy 1994: 24; Sofaer Derevenski 1997: 878; Waldron 2001: 45;

Williams 2006: 39), therefore, children can only be seen as manipulated entities within an adult world (Parker-Pearson 2002: 103; Rawson 1991: 7). The decision to choose one form of burial over another is not only to do with status as class, but also the status of the deceased as a beloved and mourned child (Sofaer Derevenski 1994: 15; Williams 2006: 39). While emotionally important to their parents, the death of a child was less likely to result in disruption between ties and obligations to other families and so there was less of a need for sharing grief with the community (Devlin 2007: 40).

Formally it is has been assumed that, at least by non-moneyed people, children are accorded a very rudimentary funeral (Barley 1995: 180; Watts 1989: 373). Whilst differential treatment can affect perceptions of children being different, 'other', and excludable, it is possible that instead they reflect economical issues, and the inability to bear the expense of providing the full rites to a child (Canon 1995: 8; Scott 1999: 122). Consequently, differential treatment may not reflect the feelings withheld about the child (Scott 1999: 122), with most parents making considerable efforts and sacrifices to ensure the survival of their children (McKee 1984: 99). It may be implied that the burial of children by past cultures can be seen as an evidence for status, an act carried out by only those who could afford to do so (Scott 1999: 122). Nevertheless, this is not necessarily true for all societies, as it follows that the richness or poverty of offerings may in no real sense reflect either the actual material conditions of a society or the actual wealth of any individual, for these may both be subordinated to social and ritual sanctions (Ucko 1969: 266).

It is, therefore, recognized that there are many factors that influence the representation of infants in archaeological contexts. The significance of which can have enormous consequences to our interpretation of the archaeological record, and so need to considered in any discussion of the archaeology of infanticide in Anglo-Saxon and medieval England.

Funerary Practice for Anglo-Saxon Children

The Anglo-Saxon period provides copious evidence for a huge variety of burial and belief (Crawford 1999: 19; Drewett *et al.* 1988: 282). However, it has often been observed that the frequency of children recovered from most Anglo-Saxon cemeteries, particularly the earlier cemeteries, is extremely low when compared to the size of the adult population (Arnold 1988: 185; Boyle & Dodd 1995: 116; Buckberry 2000: 4; Buckberry & Hadley 2001: 13; Crawford 2001: 103; 1999: 75; Devlin 2007: 54; Duhig 1998: 154; Evison & Hill 1996: 23; Härke 1997: 127; Haughton & Powlesland 1999: 203; Hines 2002: 96; Lucy 1998: 35; 1994: 26; Molleson 1991: 118; Parkhouse *et al.* 1996: 213; Richardson 2005: 99; Scott 1999: 121; Stoodley 1999: 106; Timby 1996: 17). For example, of Crawford's (1991: 21) sample of 1005 burials from Anglo-Saxon contexts only 10.1% were under five-years-old. These figures were actually an over estimation, for Crawford only used sites in her sample if they contained some burials of children; many early medieval cemeteries contain no burials aged under six years at all (Lucy 1994: 26). This is comparable with the study by Stoodley (2000) where only 38 (3.09%) individuals were aged birth-one-year from a sample total of 1230 individuals, and that by Buckberry (2000) where the average number of children under the age of five was 9.7%. Infant mortality can hardly have been as low in the Anglo-Saxon period as the mortuary statistics indicate, so other considerations must be responsible for this situation (Boyle & Dodd 1995: 116; Boylston & Roberts 1996: 175; Crawford 1999: 75; Marlow 1992b: 110).

The low proportion of young children recovered from pagan cemeteries would suggest that their inclusion in the formal burial ground is unusual. Those young children that are included within the pagan cemeteries tend to be marked out by some unusual feature of the burial (Crawford 1999: 82; Devlin 2007: 54). The few children found in Anglo-Saxon cemeteries are often interred in multiple burials (Arnold 1988: 185; Devlin 2007: 54; Härke 1997: 127; Stoodley 2000: 458), whether from contemporary burials where two or more individuals are interred at the same time or from consecutive multiple burials where the grave is reopened at some time after the first burial to allow a second or subsequent interments (Devlin 2007: 54; Stoodley 2002: 106). Of those infants recovered from a sample of Anglo-Saxon furnished inhumation cemeteries studied by Crawford (1999: 76), about 17% are included in double burials (22 out of 130 infant burials), compared to the rest of the older age groups in the mortuary population, of which 9% are buried in double or multiple graves (95 out of 1,141 burials).

Stoodley's (2002) review of multiple burials from early Anglo-Saxon cemeteries revealed that there were social rules for appropriate multiple burials; it was more common for an adult to be paired with a subadult than with another adult and there was a clear tendency to pair an adult male with an older subadult and a female with a younger one (Devlin 2007: 54; Stoodley 2002: 112). As infants often appear as an addition to the graves of adult females, it is difficult to resist the notion of mother/child burials as the explanations for many of these multiple burials (Crawford

1999: 111). Arguably, the contemporary double burials may represent two members of the same family who died simultaneously, but if two deaths coincided, it may have been a matter of convenience to bury the bodies together regardless of any lack of familial relationship (Crawford 1999: 77). Equally, if disease attacked a community, weak infants might be expected to die with their carers (Crawford 1999: 77). At Empingham II, Rutland, in a mortuary population of over 150 bodies, there were no neonates and only two burials of infants under two-years-of-age, both of whom were interred with 'wealthy' adult females (Mays 1996: 25; Timby 1996: 16). At Nassington, Northamptonshire, out of around fifty burials excavated only two infants were found, in the form of a skull buried by the hand of female burial 31, and another skull in the crook of the arm of a female burial 46A (Crawford 1999: 77; Leeds & Atkinson 1944: 110, 112). At Rivenhall, Essex, two burials, 227 and 187, contained the skeleton of an adult with associated perinatal infant (O'Connor 1993: 98).

Sometimes unusual circumstances of death have been identified, for example, there are a number of burials with foetal or neonatal bones apparently inside the pelvis (Ayres 1985: 58). These burials are often assumed to indicate the death of mother and child during labour or in late pregnancy. Examples include burial 235 from Norwich Northeast Bailey, Norfolk (Ayres 1985: 58), inhumations 107 and 188 from Lechlade Butler's Field, Gloucestershire (Harman 1998: 44), burials 32 and 127 from Great Chesterford, Essex (Evison 1994: 31). The only foetus recovered from Water Lane, Cambridgeshire, was found near the pelvis of the adult female Sk1189 (SG78), it is possible that the remains were disturbed, or that the six-months gestation foetus was stillborn and buried beside its mother (Duhig 2003: 96). Similarly at Wells Cathedral, Somerset, an infant (B217) aged between seven and eight months had been placed on top of the legs of a 25-35 year-old female (B219) (Rodwell 2001: 72). An interesting case is observed at Worthy Park, Hampshire where an infant’s body found lying head down between the thighs of a adult female in burial 26 was deliberately covered by a layer of chalk (Chadwick Hawkes & Grainger 2003: 33; Hawkes & Wells 1983: 24).

Infant burials from early Anglo-Saxon sites can also be characterised by unusual grave position or furniture. In general the infants buried within the cemeteries were distinguished by a lack of grave goods in comparison to other age groups (Crawford 1999: 78; Devlin 2007: 40; Härke 1997: 127; Stoodley 2000: 458). Further differentiation is seen at Holborough, Kent; a seventh-century cemetery which contained exclusively west-east burials, except for one infant which was buried north-south (Evison 1957: 90). At Appledown West Sussex, structure 32 consists of four post holes arranged at each corner of a square, with a fifth posthole in the centre of the structure containing the cremated remains of an infant of child (Crawford 1999: 79; Down & Welch 1990: 29; Harman 1990: 199). The only neonate recovered from Berinsfield, Oxfordshire, was buried in what appeared to be an earlier pit feature containing a sheep (Boyle *et al.* 1995: 38). It is not possible to say whether those burying the neonate at Berinsfield were aware of the sheep burial, or even aware of the pit, although the choice of burial location may not have been coincidental (Crawford 1999: 60). As archaeologists we can only conjecture possible reasons for these deposits, whilst different from the adult funerary rite, the small number of examples would suggest that they do not represent the normative rite for all infants. This poses the further problem of whether these infants were considered ‘special’ by the community and worthy of an unusual and possibly more expensive funeral, or if the child had perhaps suffered an abnormal death that required additional commemoration.

There are exceptions to the general rule that pagan Anglo-Saxon sites contain low numbers of infant burials (Crawford 1999: 76). For example, the late pagan site of Lechlade Butler’s Field, Gloucestershire, contained forty-four burials of children aged six years or less, making up 25% of the cemetery population, of which twenty-five burials were of infants under three-years-of-age (Boyle 1998: 35; Crawford 1999: 76). Another Anglo-Saxon cemetery that is unusual in containing a high proportion of child burials is Great Chesterford in Essex (Crawford 1999: 66; Stoodley 2000: 458; 1999: 106); of 171 inhumations, 65 were aged less than two-years-old (Evison 1994: 28). This included fifteen foetuses, six of which were found in one grave (Evison 1994: 31; Lucy 1998: 48; McGovern 2003: 54). As the report comments ‘it is difficult to imagine how six or more foetuses of the same age can be buried in the same spot, unless the grave was marked and reopened each time for the burial of a full-term stillborn’ (Evison 1994: 31). A number of foetuses in one grave may appear unusual but it does not necessarily imply that infanticide was practiced. Crawford (1999: 66) argues that the foetuses found at Great Chesterford demonstrates that even infants who had not come to full term were seen as worthy of burial in the main cemetery, at the least by some pagan Anglo-Saxon communities. That we do not generally have a similar picture at other sites is something that needs explanation (Lucy 2000: 139).

While there are few enough Anglo-Saxon infants recovered from cemeteries, the practice of burying infants in and around settlements does not appear to have been widely adopted by the Anglo-Saxons (Crawford 1999: 77). An exception to this rule is

Sutton Courteney, Berkshire, where an infant and female adult were buried together in a pit in the house XXIV. According to the excavator this was clearly an abnormal burial where the bodies appeared to have been hastily thrown into an overly large pit measuring nearly two metres in diameter (Crawford 1999: 77; Hamerow 2006: 14). A further case of an infant buried in the floor of a sunken featured building was uncovered at Barrow Hills, Oxfordshire in 1983 (Barclay & Halpin 1998; Bradley *et al.* 1984; Crawford 1999: 77). Excavations of Hamwic, Southampton, revealed burials of infants within pits; at SOU 13 the partial remains of a neonate (F115) were found in the upper fill of F42 (Morton 1992: 126). At SOU 36 Pit 12, the lowermost (layer 4) appears to have been a rubbish layer that contained the remains of the skeleton of an infant under six-weeks-old (Morton 1992: 198). Also at Six Dials SOU 31 T3 the partly articulated remains of an infant (5804) were recovered from the rubbish pit 5736 (Andrews 1997: 204). West Heslerton in East Yorkshire, is slightly more unusual as around fifteen juvenile skeletons were recovered from the inside of sunken featured buildings on the settlement site (Buckberry 2000: 5; Haughton & Powlesland 1999). Whilst perhaps tempting, Buckberry (2000: 5) advises that these few examples of settlement burial should not necessarily be interpreted as evidence of Anglo-Saxon infanticide, nor are there are sufficient numbers of such burials within settlements to argue for a widespread practice of settlement burial for the Anglo-Saxon period. Nevertheless, as Crawford (1999: 77) notes, the strategy in many settlement site excavations has been to reveal the outline of posthole buildings and analyse deposits within sunken-featured buildings, rather than to look for the tiny bones of infants buried near such habitations.

The lack of infant burials in pagan Anglo-Saxon contexts contrasts noticeably with the more plentiful number of infant burials found in later Christian cemeteries (Crawford 2001: 103; Devlin 2007: 54; McGovern 2003: 59; Scott 1999: 109). Of those 112 individuals to whom it was a possible to assign an age in the late Christian Anglo-Saxon cemetery at Norwich North-East Bailey, Norfolk, 45% of the cemetery population were infants under the age of five, including 13 foetuses (Crawford 1999: 76; Lucy 1994: 27; Stirland 1985: 51; Stoodley 1999: 106). Furthermore, at the late Anglo-Saxon church cemetery at Raunds, Northamptonshire, 48% of the individuals excavated were under the age of six years at death (Powell 1996: 113).

This increase in the representation of infants in the mortuary population from the early Anglo-Saxon period to the late Anglo-Saxon period is unlikely to have been caused by increased mortality rates; it is much more likely to be the result of change in burial practice (Crawford 1999: 76; Lucy 1994: 27; Marlow 1992b: 110). These higher rates of archaeological recovery suggest that those pre-Christian sites with few or no young burials must either have adopted a unified practice of shallow infant burial or that such young burials were generally not placed within the bounds of the cemetery to begin with (Boyle & Dodd 1995: 116; Duhig 1998: 161; Lucy 1994: 27; Marlow 1992b: 110; Mays 1996: 25). It seems to be a general pattern that Christian cemeteries contain high proportions of younger burials while pre-Christian sites can be typified by their general absence.

The higher representation of infants within later Christian sites could be the result of social grouping, with their spatial distribution within the churchyard possibly being more favourable to archaeological recovery (Ayres 1985: 58; Lucy 1994: 27). At many of the later Anglo-Saxon Christian cemeteries there is evidence for the clustering of infant burials around the walls of the church; it has been suggested that location was deliberately chosen so that those buried could be 'double-blessed' by the water dripping from the eaves of the holy roof (Buckberry 2007: 124; Craig 2006: 81; Crawford 2001: 103; 1999: 87; Daniell 1997: 128; Hadley 2004: 309; 2001: 48; Lewis 2007: 32; McGovern 2003: 58). Examples of cemeteries with 'eaves-drip' burials include Cherry Hinton, Cambridgeshire; Compton Bassett, Wiltshire; Nunnaminster, Winchester; Rivenhall, Essex; St. Peter's Barton-on-Humber, Lincolnshire; and Raunds Furnells, Northamptonshire (Boddington 1987a: 419; Devlin 2007: 55; Hadley & Buckberry 2005: 144; Lucy & Reynolds 2002: 17). Excavations from some sites have revealed groups of infants clustered along the east side of the church, for example at Raunds Furnells Northamptonshire; Jarrow, Tyneside; and Whithorn Priory in Galloway, Scotland (Craig 2006: 81; Crawford 2001: 103; 1999: 87; Daniell 1997: 128; Hill 1997: 557; Lewis 2007: 32; Lucy 1994: 28). Indeed, for Hartlepool Church Walk, County Durham, the presence of a cluster of infant burials was used to locate the probable site of the lost church (Buckberry 2007: 124; Crawford 1999: 87). The practice of 'eaves-drip' burial seemed to die out after 1066, and later child burials usually appeared in either the western or eastern ends of the cemetery (Daniell 1997: 128; Lewis 2007: 32).

Another possibility is that infants and children may not normally have been buried in adult cemeteries in the pre-Christian period (Booth *et al.* 2007: 174; Crawford 1999: 76; Drewett *et al.* 1988: 266), except in unusual cases like Great Chesterford (Lucy 2000: 139). High child mortality may, however, have prevented parents becoming emotionally attached to their offspring until an age when it was considered that their chance of survival had risen (Stoodley 2000: 459). As Scott (1999: 122) speculates, the costs involved in burying an infant may have been considered just too high for some parents, especially given that they might lose perhaps five or six babies in a lifetime. Perhaps parents did have profound feelings for their children but simply could not afford formal funeral for them (Scott 1999: 122).

Other, less archaeologically visible methods, may have been used to dispose of infants (Arnold 1988; Scott 1999: 121), such as cremation without subsequent burial (Crawford 2001: 103). However, as Crawford (1999: 76) points out, although there may be some evidence suggest a proportionately high number of juveniles in cremation pots from sites such as Caistor-by-Norwich, Norfolk (Myres & Green 1973), and Spong Hill, Norfolk (Hills 1977). From other sites this is not the case, for example at Newark Millgate, Nottinghamshire (Kingsley 1989), infants were under-represented in the cremation record (Crawford 1999: 76). Until relatively recently there was often a tendency to regard archaeological cremation burials as something of a 'poor relation', particularly within periods noted for their artefact-rich inhumation burials, such as the early Anglo-Saxon period (McKinley 2006: 81). Research by McKinley (2006: 81), however, has shown that by involving both the cremation process and subsequent burial the cremation rite was actually rather complex and expensive in terms of the time expended in its undertaking and the required additional commodities (fuel, pyre and grave goods). Interestingly at the large cremation cemetery of Caistor-by-Norwich, Norfolk, the report noted that children's cremation urns showed a higher level of decoration and associated objects than those of adults, implying that more care was taken over these burials (Crawford 1999: 80; Myres & Green 1973).

It may be that under representation of younger remains is a result of preservation conditions, with small infant bones being dissolved more thoroughly by acidic soils (Lucy 2000: 139; Stoodley 2000: 458; Wells *et al.* 2003: 159). Research by Buckberry (2000) indicated that children were highly under-represented in cemeteries from the earlier Anglo-Saxon period. However, most of the earlier cemeteries included in Buckberry's (2000: 4) study (twelve out of sixteen sites) were on sandy or gravel soils, both of which are believed to be poor preservers of bone due to their acidic pH (Bethell & Carver 1987: 13; Henderson 1987: 46), and indeed the adult skeletons recovered from these early sites were also poorly preserved. Although more children were represented from cemetery sites of the middle and later Anglo-Saxon periods studied by Buckberry (2000: 5) these later sites were more frequently located on chalk and clay which allows for better bone preservation (Henderson 1987: 46), and as such it is unsurprising that the adults recovered from these sites were also better preserved (Buckberry 2000: 5). It is argued by Buckberry (2000: 5) that this does not seem to reflect a change in the burial rites accorded children, but rather a change in the geology of the cemetery locations. There are, however, some variations, for example the early Anglo-Saxon site of Great Chesterford, where 40.1% of burials were of children under the age of five years, despite the sandy gravel soils at the site (Buckberry 2000: 4).

A further consideration is the possibility that within the earlier pagan cemeteries the infants were buried shallowly (Arnold 1988: 185; Crawford 2001: 103; 1999: 76; Leeds & Harden 1936: 29; Lucy 2000: 139; Stoodley 2000: 458). Small skeletons in shallow graves are more easily disturbed; sometimes it may be due to inadequate excavation with poorly preserved infant bones easily being missed, especially if grave-cuts are hard to see (Crawford 2001: 103; Lucy 2000: 139). For example, the grave of a six-to-seven-month-old foetus from Lechlade Butler’s Field, Gloucestershire (burial 198) was so close to the top of the gravel that it was largely removed during the mechanical stripping of the site (Boyle *et al.* 1998; Crawford 1999: 76). Research by Cherryson (2007) indicated increasing levels of grave disturbance throughout the Anglo-Saxon period with a higher concentration of intercutting burials in the late Saxon churchyards, thought to be at least partly the result of the church enclosing burial grounds and implementing policies restricting burial. The increased disturbance and complicated stratigraphy of the later sites may possibly cause some young individuals to be recorded more than once through bone displacement from the original grave.

Another factor that should be taken into account is the date of publication for the cemetery reports. The grave inclusions of pagan Anglo-Saxon burials excited much interest from the early excavators, however, unfortunately the quantity of graves excavated has not always been matched by the quality of the excavation and the methods of recording (Booth *et al.* 2007: 177; Crawford 1999: 16; Drewett *et al.* 1988: 282; Hills 1979: 318; Lucy 2000: 139; Lucy & Reynolds 2002: 1). Although well over a thousand cemeteries were recorded by Meaney (1964) as pagan Anglo-Saxon in date, not all of these can be regarded as reliably identified and most have only been very partially investigated (Hills 1979: 197; Lucy 2000: 139). In particular, juvenile burials were given a lower priority in earlier excavations, as their skeletons were considered to yield little useful information for the osteologist (Buckberry 2000: 4; Kjølbye-Biddle 1992: 241). Consequently the remains of children were often left unexcavated, or were given low priority during curation and publishing (Buckberry 2000: 4). Research by Buckberry (2000: 4, see table 4) indicates that for both the early and the mid-late

Anglo-Saxon cemeteries there is a tendency for the numbers of juveniles recovered to increase over time, with those sites excavated in the 1990's providing a higher proportion of subadults than the 1980's excavations (Buckberry 2000: 4). This may indicate an increasing awareness on the behalf of the excavators regarding the importance of the remains of children (Buckberry 2000: 4). However, it may also reflect the priority of the earlier investigations for excavating the graves with the larger amounts of grave goods (usually the graves of adults), and is a reflection of the change from selective to total excavation (Buckberry 2000: 4). This would also partly explain the higher percentages of juvenile burials recovered for the middle and later cemeteries, which usually contained few or no grave goods (Buckberry 2000: 4; Crawford 1999: 78; Devlin 2007: 40; Härke 1997: 127; Stoodley 2000: 458).

It has, however, been suggested that the explanation for the dearth of infant burials in Anglo-Saxon cemeteries could be that infanticide was practiced (Arnold 1988: 185; Daniell 1997: 125; Morton 1992: 52; Scott 1999: 122). Often, when infanticide is a common practice within a society, the babies killed would not be accorded community burial, but rather their disposal would remain a private family matter and might take place within the environs of the domestic or agricultural sphere (Damme 1978: 3; Gowing 1997: 88; Scott 1999: 122; Stoodley 2000: 458). It has further been proposed that the higher ratio of adult males to females from some sites such as Raunds in Northamptonshire, Berinsfield in Oxfordshire, and North Elmham in Norfolk would support an interpretation of sex-biased infanticide (Boswell 1989: 263; Crawford 1999: 63; Molleson 2003: 122; 1991: 119). It is comments such as these within the archaeological literature that this research project aims to investigate through the analysis of the osteoarchaeological record.

Medieval Burial of Children

In medieval Christian belief, inhumation within cemeteries was the main funerary rite and therefore, given the supposed high infant mortality rate in this pre-antibiotic era, we would expect the burial of children to be relatively common (Daniell 1997: 124). In some cemeteries this is evident in the archaeological record, for example, the largest single category from Barton Bendish, Norfolk, was children aged from birth to five-years-old (Rogerson & Ashley 1987: 44). At St. Andrews Fishergate, York, 36.6% of the burials were aged under twenty-years and more than half of these were under five-years-old (Lucy 1994: 27; Stroud & Kemp 1993). However, a frequent feature of excavated medieval cemeteries is that children and infants are underrepresented (Bruce & Cox 1995: 981; Daniell 1997: 125; Miller & Saxby 2007: 149; Molleson 2003: 122; Rogerson & Ashley 1987: 44; Waldron 2005: 26; Wilkinson 1998: 15). Burial of infants within or adjacent to monastic churches was relatively rare: for example, only one infant was interred at Cistercian Stratford Langthorne, and two at Augustinian St Mary Merton (Barber *et al.* 2004; Gilchrist & Sloane 2005: 223; Miller & Saxby 2007). At St Helen-on-the-Walls in York, only twelve infants were recovered, and those that were found were buried with adults (Daniell 1997: 125; Dawes 1980: 63). This was considered by the excavators to be the result of infant burials being clustered at the north side which remained unexcavated (Lewis 2007: 33). However, during later archaeological investigations at the site this hypothesis proved ill-founded, and the infants appear to have been afforded another, unknown, location for their burial (Daniell 1997: 127; Grauer 1991: 411; Lewis 2007: 33).

Newborns were considered to be corrupted by the Original Sin of their conception (Finucane 1981: 54; Hanawalt 1986: 172; Shahar 1990: 14), and unbaptised or stillborn infants were not permitted burial in consecrated ground, which occurred from the tenth century onwards (Buckberry 2008: 149; Cherryson 2008: 122; Daniell 1997: 127; Finucane 1981: 54; Gilchrist & Sloane 2005: 72; Gittos 2002: 201; Holloway 2008: 131; Kellum 1974: 374; Lewis 2007: 33). Nevertheless, in 1398 the secret burial of unbaptised infants was cited as one of the reasons for a royal license given to the Dean and Chapter to enclose the Hereford Cathedral cemetery and to keep the gates locked at night (Daniell 1997: 127; Gilchrist & Sloane 2005: 72; Shoesmith 1980: 51). This license seems to be substantiated by the discovery of twenty-four infants shallowly buried in a haphazard manner in an extended part of the cathedral cemetery (Bayley 1980: 45; Lewis 2007: 33; Shoesmith 1980: 51). Similarly, a 1493 London court case relates how, after delivering a stillborn baby, a midwife requested another woman to illegally bury the child within the confines of Pardon graveyard in the parish of St. Nicholas in the Shambles (Donnelly & Murphy 2008: 213).

The custom of burying infants under the eaves of churches seems to have died out post-Conquest. However, there is still evidence of clustering within medieval cemeteries with infants sometimes clustered along the boundary walls or ditches of cemeteries, or around features such as porches or paths (Hadley 2001: 47; Lewis 2007: 32). For example, at the Gilbertine priory of St. Andrew, York, twelve infants were located near the south wall of the cemetery and two at the porch entrance (Gilchrist & Sloane 2005: 67; Stroud & Kemp 1993). Also at the Benedictine priory of St. James, Bristol, the primary north cemetery was marked by six infant burials, three of which were interred in coffins (Gilchrist & Sloane 2005: 67). At Kellington, Yorkshire, a cluster of juvenile burials has been found outside what was the east end of the chancel (Daniell 1997: 128; Mytum 1994), and a cluster of infant burials has been excavated on the north side of the tower at Bolsover, Derbyshire (Hadley 2001: 48). The Jewish cemeteries excavated in York and Winchester reveal more definitive evidence of clustering of infant burials; at Winchester, 48 infants were buried predominantly to the east of an early boundary ditch (Gilchrist & Sloane 2005: 70). At the contemporary site at Jewbury, York, 59 infants were recorded in the north-east of the cemetery area (Gilchrist & Sloane 2005: 70; Lilley *et al.* 1994: 333; Stroud 1994: 431).

The zoning of burials in a cemetery can have a dramatic impact on the perceived nature of the cemetery (Clough 2006: 108; Daniell 1997: 128), however, there is a predominant association of the western region of the church with infant burial within many medieval cemeteries (Gilchrist & Sloane 2005: 67). At the Augustinian priory of SS Peter and Paul Taunton, Somerset, 85% of the non-adults were located at the western end of the cemetery, while only three children were excavated from the east (Daniell 1997: 128; Gilchrist & Sloane 2005: 67; Leach 1984; Lewis 2007: 32). Similarly at St Andrew Fishergate, York, 76% of burials aged under five-years from the earlier period of cemetery use were found in the western third of the excavated area (Lucy 1994: 28; Stroud 1993: 170). The west end of the church was also favoured at St Margaret's-in-Combusto in Norwich, Norfolk; St Mary Bredin in Canterbury, Kent; Hartlepool Greyfriars, County Durham; Chester Dominicans, Cheshire; Aberdeen White Friars, Aberdeenshire; and Linlithgow, West Lothian (Ayres 1990: 59; Blockley *et al.* 1995: 390; Cross & Bruce 1989: 119; Daniell 1997: 128; Gilchrist & Sloane 2005: 67; Stones 1989: 112).

In positioning the corpse in the grave, infants seem to have been the only age group that was associated with a particular body position (Gilchrist & Sloane 2005: 223). They were often placed on their sides perhaps emulating a sleeping position and demonstrating the care with which their interments were completed (Gilchrist & Sloane 2005: 223). This contrasts with a small number of infants and neonates who were buried prone, possibly denoting interment of the unbaptised (Gilchrist & Sloane 2005: 223). For example, at the Priory and Hospital of St Mary Spital, London there was one infant buried prone which also cut an earlier grave row, the excavators suggested this was possible evidence that the infant was not considered fully 'human', perhaps having been stillborn, or dying before baptism, it was thus buried in a random location (Thomas *et al.* 1997: 117).

In medieval cemeteries it is not unusual to find a foetus with a female skeleton, either still in the womb or beside or on top of the body (Daniell 1997: 125). Examples include the Augustinian friary in Hull, where a woman was buried in a coffin, and a child was buried in a tiny coffin by her leg (Daniell 1997: 126). Two examples from St-Helen-on-the-Walls, York (5595 with 5594 and 5575 with 5791), led the excavators to suggest that a joint interment was the normal practice, although the density of burials made it difficult to determine in many instances whether an apparent association was valid or simply fortuitous (Dawes & Magilton 1980: 11). At the Hospital of St John of Jerusalem, Clerkenwell, London, the young female (518) was excavated with the full term foetus (549) *in situ* in the birth position, with the head of the child already rotated down towards the pelvic canal (Conheeney 2004: 399).

Excavation has occasionally revealed infant burials within medieval settlements, in buildings or the crofts of houses (Hadley 2001: 51; Ivens *et al.* 1995: 31). In the medieval village of Upton, Gloucestershire, a three-to-six-month-old baby was excavated from under the floor of a thirteenth-to fourteenth-century long house (Rahtz 1969: 74; Spence & Moore 1969: 123). The sealed grave of the infant was discovered in the south-west corner of the house and the excavator noted the possible association of a spindlewhorl and also a large whelk-shell that was found close by (Rahtz 1969: 87). At the settlement of Tattenhoe the articulated remains of a human infant, possibly a still-born baby, dating to the late thirteenth century were found in a shallow depression below Building 4 (Ivens *et al.* 1995: 31). The child may have been interred during the construction of the building, perhaps as a foundation deposit, or placed below the wall at a later date (Ivens *et al.* 1995: 31). Burial beneath the building may have been purely coincidental or convenient but perhaps we are witnessing a more ritualistic event associated with the foundation or dedication of the building (Ivens *et al.* 1995: 31). The deposition of animal bones with the body may also indicate ritual and a certain quasi-pagan element (Ivens *et al.* 1995: 31). A five-to-seven-month-old foetus was also discovered interred under the southern wall of the late eleventh-century building Croft 13 at the nearby Westbury-by-Shenley (Ivens *et al.* 1995: 146). It is difficult to say whether these are evidence of a secretive act, perhaps done in the wake of an act of infanticide or because of the death of the child before it had been baptized, for example (Hadley 2001: 51; Ivens *et al.* 1995: 31). In some cases it cannot have been an attempt to conceal the birth of a baby since the child was several months old (Hadley 2001: 51; Rahtz 1969: 87). Rahtz (1969: 88) suggests that avoiding burial in a consecrated graveyard indicates an interesting defiance of ecclesiastical authority, perhaps simply in the unwillingness, or inability, to pay burial and baptism fees.

As with the Anglo-Saxon period, excavations of the British medieval cemeteries have generally revealed a lower proportion of infants than would be expected from a preindustrial society. Again the dearth of infants has led some to suggest the possibility of infanticide, particularly when the adult sex ratio is also observed. It is not surprising that a monastery, full of males, should produce predominantly male cemeteries (Daniell 1997: 126; Hanawalt 1986: 102; Molleson 1991: 119; Thrupp 1966: 477). Nevertheless, the difference is sometimes extremely marked, for example at the Cistercian monastery of Stratford Langthorne, Essex, only one burial was that of a female out of a total of ninety-five (Barber *et al.* 2004; Daniell 1997: 126), and of the 44 sexed adult burials from Lewes Friary in West Sussex 95% are male (Browne 1996: 117). Also of the 664 skeletons recorded from Merton Priory in Surrey there was a marked male bias amongst the adults with 77.2% males and 6.9% females providing a male to female sex ratio of 11.2:1 (Miller & Saxby 2007: 266). Yet this poses another problem: if it is assumed that the population was roughly equal between male and females, it would be expected that – to make up the large number of male monasteries which far outnumber nunneries – the local parish population would have a correspondingly higher female presence (Daniell 1997: 126). In fact Daniell (1997: 126) notes that the numbers of male/female burials from six parish cemeteries (Rivenhall, Essex; Barton Bendish, Norfolk; St Nicholas Shambles, Essex; St Helen-on-the-Walls, York; and Norwich North-East Bailey, Norfolk) are remarkably similar (544 males, 546 females, 421 subadults). Occasionally there is a higher number of female burials, as at Rivenhall (31 male burials, 40 female) (O'Connor 1993: 97), but they do not make up the shortfall (Daniell 1997: 126). At rural Wharram Percy in North Yorkshire the adult sex ratio was 1.58:1 in favour of males (Mays 2000: 185). Mays

(2000: 185) believes that the best explanation for the shortage of females is their emigration toward the urban centres, which in the case of Wharram Percy would be York, causing a rural sex ratio dominated by males. However, this is not necessarily supported by the burial record. One answer for the discrepancy between the sex ratio is that widespread infanticide especially of girls, may have occurred in medieval England (Daniell 1997: 126).

Conclusion: The Archaeological Representation of Anglo-Saxon and Medieval Children

This chapter has indicated that there was a large variation in funerary practice of subadults in England during the Anglo-Saxon and medieval periods. In particular the almost complete lack of infant burials from most pagan Anglo-Saxon contexts contrasts noticeably with the more plentiful number of infant burials found in later Christian cemeteries (although children still tend to be underrepresented in Christian cemeteries). The extremely low proportion of young children recovered from most pagan Anglo-Saxon cemeteries would suggest that their inclusion in the formal burial ground is unusual. This would be supported by the fact that those young children that are included within the pagan cemeteries tend to be marked out by some unusual feature of the burial - either as multiple burials, or distinguished by a lack of grave goods in comparison to other age groups. It is possible that the cremation was performed as the preferred funerary rite for subadults during the pagan Anglo-Saxon period. It was also identified that this discrepancy could possibly be as a result of social grouping, in particular the ‘eaves-drip’ burials in Christian Anglo-Saxon cemeteries and clustering along the boundary walls or ditches in medieval Christian cemeteries allowing for more favourable recovery.

The under-representation of young children recovered from Anglo-Saxon and medieval cemeteries has been provided by some researchers, along with the higher ratio of adult males to females from some sites, as evidence to support the practice of sex-biased infanticide in both the Anglo-Saxon and the medieval periods. However, this review has revealed that there are many factors, including differential preservation, recovery and deposition of skeletal remains, which influence the representation of infants in archaeological contexts and conspire to render osteological samples incomplete and under-representative of the population. These issues and the biasing effect that they have on the Anglo-Saxon and medieval burial populations examined for this osteoarchaeological analysis will need to be considered in the discussion of the results presented in Chapter 11.

Chapter 8

Subadult Palaeopathology

Introduction

The discussion of the practice of infanticide in human society in Chapter 2, indicated that most methods of infanticide do not leave forensically detectable traces of violence (Scott 1999: 66; Wileman 2005: 89). It was, therefore, thought unlikely that any direct skeletal evidence for infanticide would be observed in the Anglo-Saxon and medieval assemblages. However, it was also reported in Chapter 2 that devalued children can be neglected by their parents, causing the child to succumb to malnutrition or infection a process described as passive infanticide (Scrimshaw 1984: 449; Steele 1978: 84). A palaeopathological examination of Anglo-Saxon and medieval individuals can, therefore, not only provide some indication as to the health of the archaeological populations but also, when compared to the mortality profiles, may allow for further discussion and interpretation of the role of passive infanticide on the burial samples.

This chapter examines some of the complications of palaeopathological analysis and the problems of differential and paradoxical diagnoses from skeletal lesions. The different forms of pathological lesions that can be observed on juvenile skeletal remains and their potential aetiology are described. This commences with those non-specific pathologies that nonetheless indicate an increased amount of stress including periosteal bone reaction, porotic hyperostosis, dental enamel hypoplasia, and dental caries. The metabolic diseases, which cause the disruption of normal bone formation, are then reviewed including a discussion of the different skeletal manifestations of anaemia, rickets, and scurvy. An analysis is then made of the pattern of lesions caused by infection including osteomyelitis and infectious diseases such as tuberculosis, leprosy, treponematosis and smallpox. Traumatic injuries are also discussed highlighting the potential to identify child abuse or birth trauma from the pattern of lesions.

The Examination of Morbidity and Mortality through Palaeopathological Analysis

The morbidity (defined as the occurrence of illness) experiences of a population are affected by genetic predisposition, age, sex, ethnic group, physiological state, prior exposure to pathogens, inter-current or pre-existing disease, as well as human behaviours such as occupation, diet and hygiene (Angel 1969: 427; Lallo & Rose 1979: 323). Mortality as a response to morbidity is an index of the general health status of a population (Lallo & Rose 1979: 324). An important factor in the morbidity of human populations is the role of nutrition, particularly in the younger, more vulnerable individuals. If nutrition is inadequate there is an increase in infection rate through lowered resistance, malnutrition is further exacerbated by the infectious disease which reduces the efficiency of nutrient absorption (Lallo & Rose 1979: 324; Rose *et al.* 1985: 291; Roth 1992; Scott & Duncan 1999: 40). The pattern of mortality shows diachronic changes as there appears to be a distinct difference between mortality curves between earlier and more recent populations (Roberts & Manchester 2005: 27). It is therefore of particular interest for osteoarchaeologists to determine the significance that the role of morbidity has had upon the mortality profile of past populations (Manchester 1992: 11). A palaeopathological analysis of the Anglo-Saxon and medieval assemblages will therefore be used to discuss the morbidity response not only of the different age categories but also to explore any diachronic differences observed between the Anglo-Saxon and medieval archaeological populations.

There are complications to palaeopathological investigations for whilst the bony response of a disease may represent the primary cause of death, this is not always the case (Wood *et al.* 1992: 349). Many diseases, especially acute infections such as the plague, whooping cough, smallpox, measles and scarlet fever – all of which were known to be major causes of child death in the past – usually kill before leaving evidence recorded in the bone (Keenleyside 1998: 53; Lewis 2007: 133; Ortner 1992: 5; Saul & Saul 1989: 289). This process can be accelerated during periods of famine, as the body's immune response is depressed during malnutrition and thus the likelihood of dying before the disease becomes chronic is increased (Ortner 1998: 82). Therefore skeletal lesions can be expected to develop only during periods of chronic illness and, of those, not all are known to induce quantifiable or even recognisable bony change (Eisenberg 1992: 359; Wood *et al.* 1992: 365). For example, only 3-5% of people with tuberculosis will develop bone changes (Roberts 2002: 35).

The absence of pathological lesions is more difficult to interpret. Whilst an impression of better health is created, it is possible that individuals with a lack of pathological lesions represent those that died early from the disease (Lewis 2007: 133; Ortner 1998: 82; Wood *et al.* 1992: 365). Conversely, the presence of an inactive lesion indicates survival of a disease process earlier in life and thus may signify an individual whose frailty is low compared with those who died at earlier ages (Wood *et al.* 1992: 252). It is, therefore, a possibility that individuals displaying lesions may actually be healthier than at least some individuals without lesions (Wood *et al.* 1992: 345). However, children are differentially susceptible early in life, and once stresses have been experienced they are likely to remain frail throughout early childhood, therefore, skeletons with healed lesions are selectively added to the mortality sample (Wood *et al.* 1992: 253). Nevertheless, the skeletal samples consist of individuals who failed to survive and therefore they and their pathological conditions are a biased representation of individuals in the population who were alive at a given age (Cook & Buikstra 1979: 649; Keenleyside 1998: 53; Stini 1985: 192; Wood *et al.* 1992: 349). Paradoxically, although survival from certain disease might be considered an improvement in health this produces the increase in the proportional mortality from the remaining causes (Wood *et al.* 1992: 252).

Non-specific Indicators of Stress

It has been recognised that both bone and enamel formation may respond to changes in health, often through its influence on nutrition (Duray 1996: 275; Goodman & Armelagos 1989: 239; May *et al.* 1993: 39; Palubeckaitè *et al.* 2002: 189). The emphasis of morbidity studies of archaeological populations is, therefore, placed on the analysis of non-specific skeletal indicators of stress (Lewis 1999; Palubeckaitè *et al.* 2002: 189). Those commonly discussed within the literature include periosteal bone reaction, porotic hyperostosis, dental enamel hypoplasia, and dental caries (Larsen 1995: 192; Lewis 1999). Whilst these indicators are used to suggest an increased amount of stress, it is difficult to determine whether this is a result of disease (including 'pestilence and plague'), or dietary deficiency, or a combination of both (Roberts & Cox 2003: 185). Many osteoarchaeologists therefore use a multidisciplinary approach to the analysis of the morbidity of archaeological populations as this provides a more comprehensive elucidation of aspects of population history and dynamics (Goodman 1993; Palubeckaitè *et al.* 2002: 189).

Periosteal Reaction

Proliferative periosteal reactions (often just termed ‘‘periostitis’’) are a common occurrence in archaeological skeletal remains, frequently observed on the long bones, especially the tibiae (Weston 2008: 48). The periosteum is the fibrous sheath that covers all the bones of the skeleton with the exception of the endocranial surface of the cranium and the joints (Lewis 2000: 42). The germinative inner layer of the periosteum, which retains the potential to form bone throughout life, is vulnerable to traumatic separation and haemorrhage (Lewis 2000: 42; Ortner 2008: 196). The skeletal response to this inflammatory process manifests initially as fine pitting and appearance of woven bone and remodels over time into lamellar bone (Roberts & Manchester 2005: 172; Weston 2008: 48), see Figure 8.1 for an example periosteal new bone formation. A bone that exhibits periosteal new bone production did not necessarily come from an individual whose body was invaded by a pathogenic organism, nor does it even necessarily involve inflammation as periosteal new bone production can result from almost anything that breaks, tears, stretches, or even touches the periosteum (Weston 2008: 57).

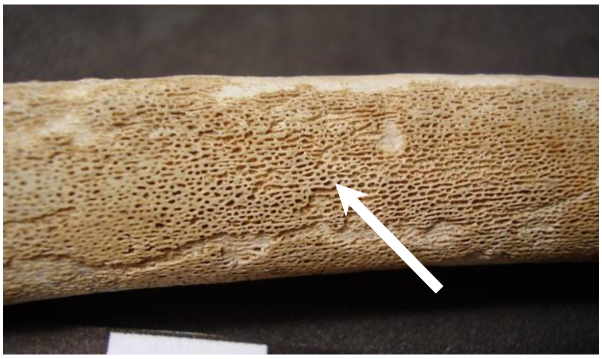


Figure 8.1: Chichester C159 periosteal new bone formation.

There are also several forms of infant pathology which cause a separation of the outer layer of the cortical bone, porosity of its outer surface and increase of compact tissue; the more common of which include rickets and other entities relating to the lack of vitamin D, scurvy, congenital syphilis and other treponematoses, tuberculosis and bacterial osteomyelitis (Malgosa *et al.* 1996: 492). Infantile Cortical Hyperostosis or Caffey's disease is an uncommon condition that also affects the periosteum where profuse layers of new bone are formed in the early stages of the condition causing the bone to appear thickened while the medullary cavity retains its normal appearance (Lewis 2007: 144). As the condition stabilises remodelling begins from the endosteal surface, causing the medullary cavity to widen and the bones to become more fragile (Lewis 2007: 144).

Endocranial Lesions

Endocranial lesions appear as diffuse or isolated layers of new bone on the original cortical surface, expanding around meningeal vessels; described by Lewis (2007: 141) as 'hair-on-end' extensions of the diploe or as ‘capillary' impressions extending into the inner lamina of the cranium (examples are shown in Figures 8.2 and 9.3). These lesions are commonly found on the occipital bone, outlining the cruciate eminence, but have also been recorded on the parietal and frontal bones and appear to follow the areas of venous drainage (Lewis 2000: 48). The exact aetiology of each type of lesion is still difficult to distinguish; however, histological evidence does suggest that hair-on-end lesions are the result of inflammation perhaps secondary to infection, whereas new bone formation results from haemorrhage (Lewis 2004: 95). Research by Teschler-Nicola and colleagues (1998) and Jankauskas (1999) suggest that lesions associated with tuberculosis meningitis are more likely in the form of small 'corn-sized' granulomas (cortical foci), producing lesions similar to an arachnoid granulation (Lewis 2004: 86). The aetiology of endocranial lesions is still, therefore open to debate as trauma, primary and secondary infections of the meninges, tumours, tuberculosis, syphilis and vitamin deficiencies of A, C and D may all result in tearing or inflammation of the meninges resulting in new bone formation (Lewis 2004: 93).

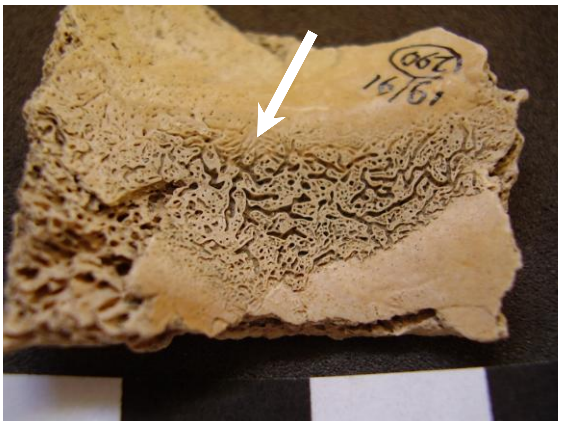


Figure 8.2: new bone formation on the endocranial surface of Gloucester Blackfriars 290 displaying vascular impressions.

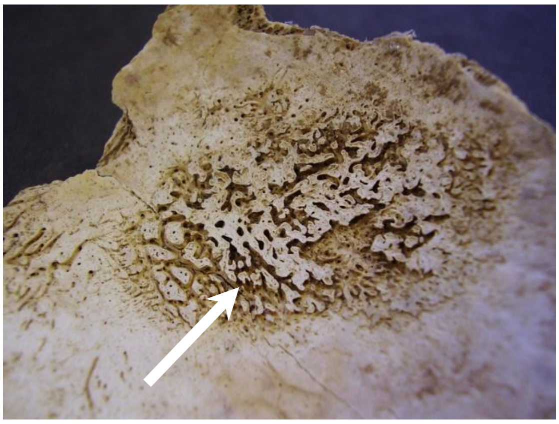


Figure 8.3: Chichester 105 with 'hair-on-end' endocranial lesion with frosted appearance.

Porotic Hyperostosis

Porotic hyperostosis is characterised by lesions identified macroscopically as circumscribed areas of pitting and porosity usually found bilaterally on the external surface of the frontal and parietals and less frequently the occipital (see Figure 8.4) (Aufderheide & Rodriguez-Martin 1998: 348; Lewis 2000: 45; Schultz 2001: 131; Walker *et al.* 2009: 109). Cribra orbitalia is a similar condition seen in the orbital roofs (again usually bilaterally) (see Figure 8.5), with both conditions being the result of a thinning of the outer table of the skull and expansion of the inner diploic space (Lewis 2000: 45). Cribra orbitalia and porotic hyperostosis are two of the most commonly reported pathological conditions in archaeological collections of human skeletal remains, although the latter is rarely reported from European samples (Lewis 2000: 45; Schultz 2001: 131; Walker *et al.* 2009: 109). However, these changes are much more frequently seen in subadults than in adults (Aufderheide & Rodriguez-Martin 1998: 349; Schultz 2001: 131). The aetiology of cribra orbitalia and porotic hyperostosis is an ongoing discussion within the palaeopathological literature. Whilst the lesions have often been discussed only in connection with iron-deficiency anaemia (see below), other inflammatory processes of the scalp and cranium (such as periostitis, osteitis, and osteomyelitis), and hemorrhagic processes (such as traumatic ectocranial hematoma and scurvy) can produce a thickened porotic external surface of the skull vault (Schultz 2001: 131). Additionally, other diseases, such as tumours (for example, haemangioma, meningioma) or even rickets, can be responsible for the morphological appearance of porotic hyperostosis (Schultz 2001: 131). It has, therefore, been indicated that porotic hyperostosis and cribra orbitalia are not characteristic of a specific disease, but rather they represent a morphological feature and so it is suggested that they should be viewed as descriptive, rather than diagnostic terms (Lewis 2007: 113; Schultz 2001: 131).

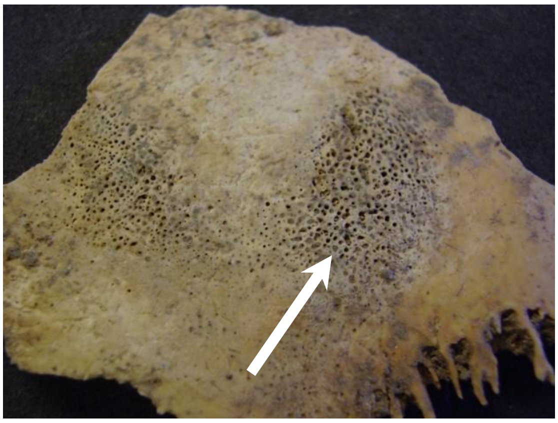


Figure 8.4: Porotic hyperostosis on Cherry Hinton 3546.

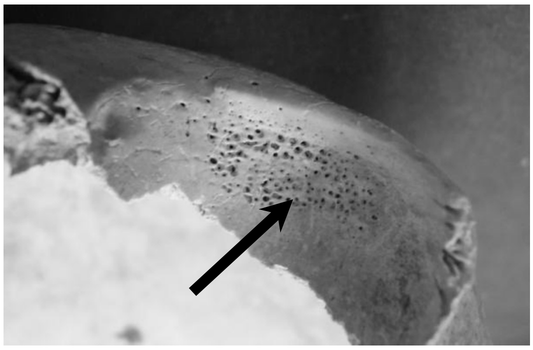


Figure 8.5: Cribra orbitalia on Stonar 74.

Enamel Hypoplasia

Linear or pitted defects in enamel have long been used as a non-specific indicator of systemic physiological stress during early life (Ogden 2008: 284). Bouts of malnutrition, disease and fever are known to depress the activity of the ameloblasts and to result in the production of a thin and poorly calcified enamel matrix, with the formation of linearly distributed pits or grooves of defective enamel (Ogden 2008: 284). The pits and furrows of linear enamel hypoplasia have received the most attention within the palaeopathological literature, however, the recent studies by Ogden and colleagues (2008; 2007) also describe 'plane' and 'cuspal' enamel hypoplasia. Plane-form hypoplasia is usually bounded and overlapped by an irregular border of relatively normal enamel, but occasionally all the occlusal enamel is thin and there may be only a cervical border of relatively normal enamel (Ogden *et al.* 2007: 964). Cuspal enamel hypoplasia (see Figure 8.6) shows a combination of irregular plane-form defects with extensive and irregular non-linear pitting, but with a disruption of normal cusp formation and the formation of additional small cusps on the occlusal surface (Ogden 2008: 287). Whilst past researchers have connected dental enamel hypoplasia with weaning stress, it is now widely recognised that enamel hypoplasias can be produced by a great diversity of stressors (Blakey *et al.* 1994; Katzenberg *et al.* 1996: 185; Neiburger 1990: 232).

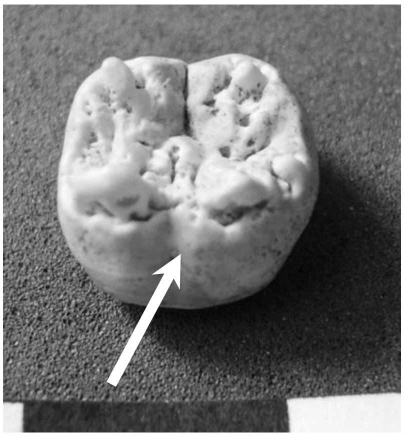


Figure 8.6: Cuspal enamel hypoplasia on Hereford Cathedral 1071.

Dental Caries

Dental caries is a multifactorial, multibacterial disease causing the progressive demineralisation of the enamel, cementum, and dentine of the tooth by organic acids, which are produced through the fermentation of dietary carbohydrates by some plaque bacteria (Aufderheide & Rodriguez-Martin 1998: 403; Hillson 2000: 260). Dental caries may occur as opaque spots on the tooth surface or as large cavities either on the crown or the root, although in subadults caries of the tooth crown predominate (see Figure 8.7) (Aufderheide & Rodriguez-Martin 1998: 403; Roberts & Manchester 2005: 66). The prevalence of caries can be affected by diet with increased prevalence of caries caused by malnutrition and with the high consumption of carbohydrates (Ogden *et al.* 2007: 958; Roberts & Manchester 2005: 66). The levels of certain trace elements in the diet can also affect the occurrence of caries, for example, fluoride can help protect a person's teeth but if intake of fluoride is too high it can lead to fluorosis which affects the integrity of teeth and bones (Roberts & Manchester 2005: 66). Other dental problems such as dental enamel hypoplasia may also weaken teeth thus aiding the destruction by dental caries (Roberts & Manchester 2005: 66).

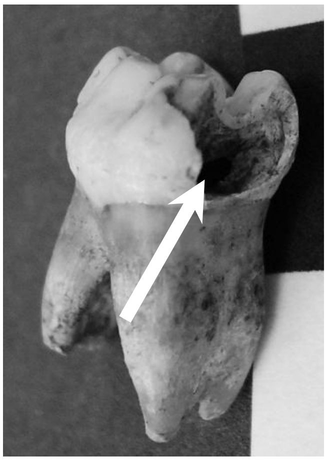


Figure 8.7: Large crown caries from Gloucester Blackfriars 182.

Metabolic Disease

Metabolic bone disease causes disruption of normal bone formation, remodelling or mineralization, or a combination of these (Mays 2008b: 215). Care is required in differential diagnosis of rickets, scurvy and other conditions in infant remains (Mays 2008b: 241). For example, rickets, scurvy and anaemia may each cause porotic lesions in the orbital roofs and cranial vault. However, in each case the final outcome of bony porosity is a result of a different process and this results in subtly different morphology (Mays 2008b: 241). In anaemia, the surface porosity is a result of marrow hyperplasia, visible in broken sections or radiographically (Mays 2008b: 241). In scurvy, lesions consist of new bone deposited upon an underlying normal cortical surface or small pores in an otherwise normal cortical surface; there is no marrow hyperplasia (Mays 2008b: 241). In rickets, bone surfaces may be rather spicular, and superficial pores are rather larger than in scurvy and represent voids as a result of imperfect mineralization of a growing surface rather than transmitting blood vessels (Mays 2008b: 241). Another complication in understanding the palaeopathology of metabolic diseases is that malnutrition is a common underlying cause and a deficient diet is likely to be inadequate in more than one nutritional requirement, for example, rickets (vitamin D deficiency) and scurvy (vitamin C deficiency) are known to have occurred together in many patients (Danforth 1999: 4; Mays 2008b: 241; Ortner & Mays 1998: 45).

Anaemia

Anaemia results from a variety of disease processes and can be defined as a reduction in concentration of haemoglobin and/or red blood cells below normal for the age and sex of the person, or a reduction in the volume of pack cells in the blood (Roberts & Manchester 2005: 226). Different types of anaemia include thalassemia, sickle cell anaemia and iron-deficiency anaemia. Thalassemia is a group of anaemias caused by a variety of genetic mutations at different sites of the gene coding for the structure of the globin chains of haemoglobin, this produces red blood cells that are formed with reduced haemoglobin content (Aufderheide & Rodriguez-Martin 1998: 347). As a hereditary anaemia thalassemia is contracted in populations bordering the Mediterranean sea and those of south-east Asia (Aufderheide & Rodriguez-Martin 1998: 347). Sickle cell anaemia is a genetic mutation at a known locus (position 6) for the gene coding for the haemoglobin beta chain (Aufderheide & Rodriguez-Martin 1998: 348). This results in the substitution of a single amino acid causing the haemoglobin to polymerise into a long insoluble molecule that distorts the red blood cell into an elongated sickle-like arc which can produce blockages in the blood flow (Aufderheide & Rodriguez-Martin 1998: 348). Another hereditary condition, sickle cell anaemia, occurs predominantly in people of sub-Saharan African origin (Aufderheide & Rodriguez-Martin 1998: 348).

Iron deficiency can arise through a lack of iron in the diet and also through blood loss from injury, menstruation, parasitic infection, and chronic disease (Danforth 1999: 4; Roberts & Manchester 2005: 226). If an individual is suffering from iron-deficiency anaemia the bone marrow produces red blood cells with subnormal haemoglobin content, this causes an increase in the production of red blood cells and subsequent expansion of the marrow (Aufderheide & Rodriguez-Martin 1998: 346). Iron-deficiency anaemia is still one of the most common health problems worldwide and it is estimated that 20-25% of the world's infants suffer from the condition with non-adults between the ages of six months and three years, along with women between the ages of 20 and 30 years, being most at risk (Lewis 2007: 113). Iron-deficiency anaemia in infants is not the result of low maternal iron levels during pregnancy, as this has been shown to have little effect on the iron content in breast milk (Lewis 2007: 113). Instead, iron-deficiency anaemia is thought to be produced by a combination of reduced iron levels in maternal milk after six months, and a depletion of the iron stores held by the infant at birth (Lewis 2007: 113). Weaning onto cows' milk may exacerbate iron deficiency if it occurs before the child is six-months-old, due to the inhibiting effects of calcium in cow milk (Ryan 1997: 25).

Skeletal changes observed in anaemia include metaphyseal widening, cortical thickening, and coarsening of the trebecular bone (Aufderheide & Rodriguez-Martin 1998: 348). However, these changes occur in the different forms of anaemia which makes the palaeopathological diagnosis to a specific type very difficult (Aufderheide & Rodriguez-Martin 1998: 348; Higgins 1989: 186). Some researchers make inferences by including non-morphological data such as geographical location or ethnicity (Aufderheide & Rodriguez-Martin 1998: 348). For example, in the study of archaeological populations from western-Europe the hereditary forms of anaemia (thalassemia and sickle cell) are usually rejected from a differential diagnosis because they are rare in northern latitudes today and are not thought to have existed there in the past. In such cases iron-deficiency anaemia is often considered the most likely cause of the morphological features of porotic hyperostosis and cribra orbitalia (shown above in Figures 8.4 and 8.5) (Lewis 2007: 112; Roberts & Cox 2003: 234; Walker *et al.* 2009: 109). Walker and colleagues (2009: 116), however, argue that that iron-deficiency anaemia does not provide a reasonable physiological explanation for the marrow hypertrophy that produces porotic hyperostosis and some forms of cribra orbitalia because humans respond to the condition by restricting red blood cell production rather than increasing it. Instead it is suggested that porotic hyperostosis and cribra orbitalia lesions may be a result of megaloblastic anaemia acquired by nursing infants through the synergistic effects of depleted maternal vitamin B12 and/or folic acid reserves and unsanitary living conditions that are conducive to additional nutrient losses from gastrointestinal infections around the time of weaning (Djuric *et al.* 2008: 468; Fairgrieve & Molto 2000: 328; Walker *et al.* 2009: 112).

Scurvy

Scurvy results from a deficiency of ascorbic acid, or vitamin C (Brickley & Ives 2006: 163; Lewis 2007: 126; Maat 2004: 78). Humans are unable to synthesize vitamin C therefore it has to be acquired from the diet mainly from fresh fruit and vegetables, although it is found to a smaller extent in other foods such as fish and dairy produce (Lewis 2008: 182; Lewis 2007: 126; Maat 2004: 78; Mays 2008b: 223; Ortner & Ericksen 1997: 213). A deficiency of ascorbic acid causes severe impairment of collagen synthesis, and this defect is responsible for the most prominent features of scurvy: defective osteoid formation and fragile blood vessels that rupture easily, leading to haemorrhages resulting from even normal movement or muscle activity such as chewing or eye motion, and which may, if it occurs adjacent to bone, provoke an osteological response (Brickley & Ives 2006: 163; Lewis 2007: 128; Maat 2004: 79; Mays 2008b: 223; Ortner & Ericksen 1997: 213). Harris (1933) carried out a survey of lesions in scorbutic children under three-years-of-age and found that evidence of haemorrhage on the skeletal system occurred in 93% of cases with 37% in the orbits, either as bilateral or unilateral lesions (Lewis 2007: 128). Eventually, internal bleeding caused by vitamin C deficiency may lead to shock and, finally, heart failure (Lewis 2007: 128; Maat 2004: 79).

Ortner and Ericksen (1997: 214) reported that the bilateral, porous lesion of the external surface of the greater wing of the sphenoid (see Figure 8.8) and adjacent bone associated with the haemorrhaging of the anterior deep temporal artery underlying the temporalis muscle was a 'virtually pathognomonic' feature of scurvy. Other skeletal lesions are in the form of bilateral porosity and, in some cases, hypertrophic bone formation most commonly on the posterior surface of the maxilla (see Figure 8.9), the inferior surface of the hard palate and in the roof of the orbits as shown in Figure 8.10 (Brickley 2000: 186; Lewis 2007: 129; Mays 2008b: 223; Ortner & Ericksen 1997: 212). The porosity is thought to occur when extra blood escaping from venous rupture stimulates a vascular response, and the formation of capillaries at the site (Lewis 2007: 130). Ossifying haematomas (see Figure 8.11), or Parrot's swellings, may form on the parietal, occipital and, in some cases, the frontal bones and mimic porotic hyperostosis (Lewis 2007: 131; Ortner & Ericksen 1997: 213). Some endocranial lesions may also be the result of slow haemorrhage of the dura as a result of scurvy (Lewis 2007: 131). In the post-cranial skeleton, the infra- and supraspinous fossae of the scapula (see Figure 8.12) and the metaphyses of long bones are favoured sites for lesions (Mays 2008a: 183).

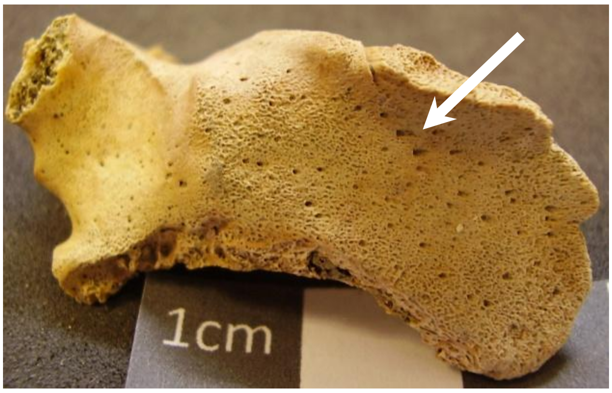


Figure 8.8: Increased porosity on the ectocranial surface of the greater wing of the sphenoid of Raunds 5165.

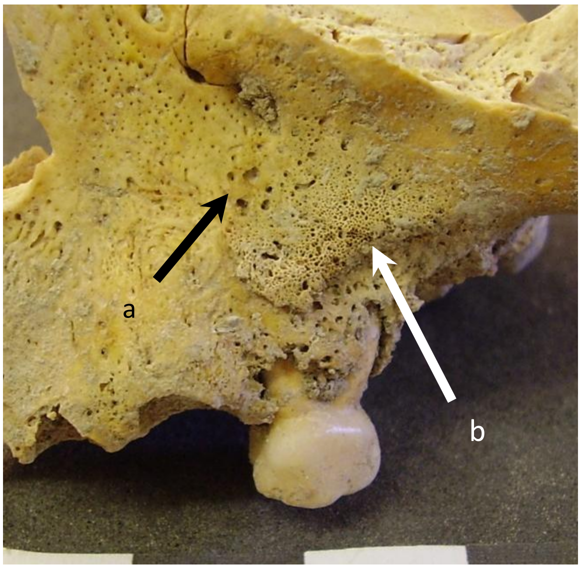


Figure 8.9: Increased porosity (a) and porous woven bone deposit (b) on the left maxilla of Cherry Hinton 4246.

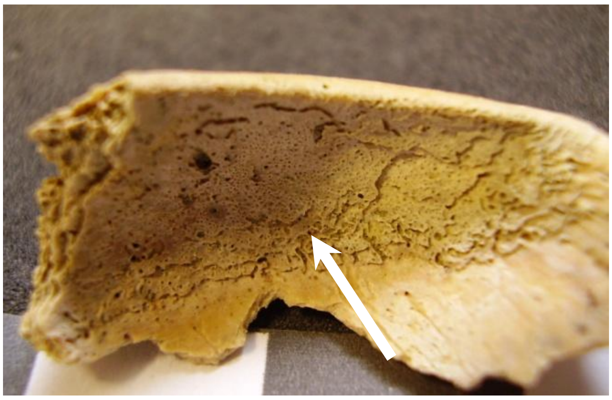


Figure 8.10: Scorbutic changes to the left orbit of Raunds 5165.

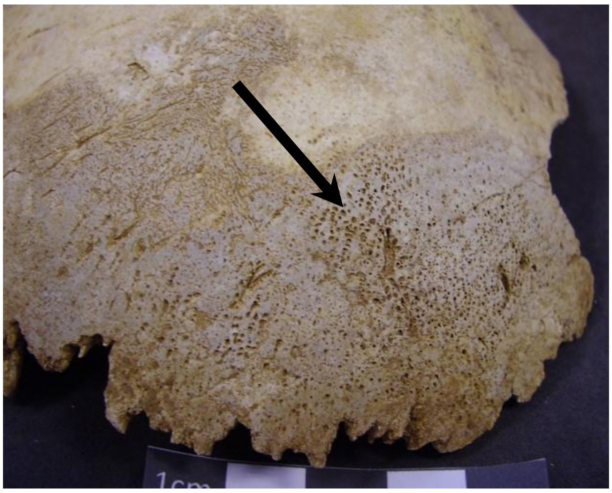


Figure 8.11: Scorbutic changes to the cranial vault of Chichester 207.

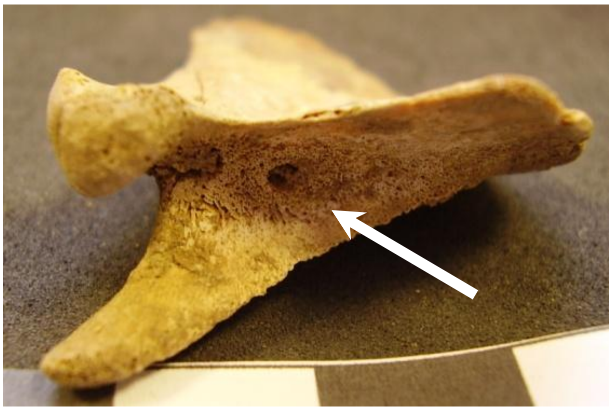


Figure 8.12: Porosity in the supraspinous fossa of the left scapula of Chichester 322.

Scurvy is clinically recognisable when vitamin C has been deficient for four to ten months, or in children, once birth stores have been depleted (Lewis 2008: 182; Lewis 2007: 126; Maat 2004: 78). Even if there is a total absence of vitamin C in the diet, the first symptoms (generally lethargy) do not generally appear until one to three months, and haemorrhages only after about six months (Mays 2008b: 223). Scurvy commonly occurs in infants between ages five and twenty-four months, with a peak between eight to eleven months with premature low birth weight babies and twins being particularly susceptible (Brickley & Ives 2006: 163; Lewis 2007: 127).

Rickets

Rickets is a condition with multiple causes although it usually results from a deficiency in the hormone commonly known as vitamin D, with inadequate exposure of the skin to sunlight being the most common factor (Lewis 2007: 120; Mays 2008b: 216; Ortner & Mays 1998: 46). Vitamin D is required to promote absorption and mobilisation of calcium and phosphorus from previously formed bone, as well as the maturation and mineralisation of the organic matrix (Brickley 2000: 188; Lewis 2007: 120). Rickets is essentially a failure to mineralize the protein precursor of bone known as osteoid, complicated by disruption of development at the growth plates (Mays 2008b: 216; Ortner & Mays 1998: 46). Bone changes due to rickets can be divided into those that are a direct result of metabolic disturbance and those that are due to mechanical deformation of weakened, poorly mineralized bone (Mays 2008b: 216). Changes that are a direct result of metabolic abnormality consist of inadequate mineralization of newly deposited bone during growth (Mays 2008b: 216). Deficient mineralization of bone deposited upon the end of the diaphysis during endochondral bone growth leads to porosis/roughening of the bone underlying the growth plate, with responses including flared costo-chondral ends of ribs, deformation of the mandibular ramus and cranial vault porosity (Brickley 2000: 188; Lewis 2000: 43; Mays

2008b: 216). Deficient mineralization of osteoid results in bones that have inadequate mechanical strength and deform easily when subject to weight bearing or muscular tension resulting in spreading and concavity of metaphyses and diaphyseal bending of long-bones (Brickley 2000: 188; Mays 2008b: 216; Ortner & Mays 1998: 46). Rickets rarely appears before four-months-of-age, because stores of vitamin D are present from birth, although it is a disease of the rapidly growing infant and young child – it infrequently occurs after about the age of four-years (Mays 2008b: 216).

Infection

The human skeleton is affected by infectious diseases primarily when the disorder does not result in rapid death (Ortner 2008: 192). People with an optimal immune reaction to infectious pathogens, as well as those who succumb quickly to infectious organisms, are unlikely to exhibit skeletal evidence of infectious disease (Ortner 2008: 192). By far the most common cause of skeletal infectious disease is pathogenic bacteria, including staphylococcus, streptococcus, mycobacteria, treponemal organisms, and brucella (Ortner 2008: 194). Viral diseases rarely affect the skeleton although one exception to this is smallpox, but skeletal involvement is uncommon (Ortner 2008: 194). Multicelled parasites, such as the larval stage of the flatworm that causes echinococcosis, can also affect the skeleton (Ortner 2008: 194).

Osteomyelitis

Osteomyelitis is defined as infection of the bone or bone marrow and is diagnosed by palaeopathologists on the presence of three very characteristic features: cloacae, sequestrated bone, and involucrum (Ortner 2008: 195). The infection most commonly results from the transmission of bacteria (often staphylococcus, although streptococcus and other organisms may also be implicated) by the bloodstream from some primarily infected area, which in modern clinical cases this is usually the throat, ear, sinuses or chest (Ortner 2008: 195; Roberts & Manchester 2005: 169). Osteomyelitis can also develop from direct injection of bacteria from the skin surface from a penetrating bone injury, or from a severe a chronic overlying skin lesion (Roberts & Manchester 2005: 171). The indirect spread of the infection through the bloodstream (haematogenous osteomyelitis) is the most common and serious form of the disease in children (Lewis 2007: 140). However, haematogenous osteomyelitis can cause septicaemia and kill the child before chronic osteomyelitis can develop, possibly accounting for the small number of child skeletons diagnosed with the condition in the archaeological record (Lewis 2007: 140).

Tuberculosis

Children are more likely to develop tuberculosis after exposure than adults, and modern estimates put the likelihood of infection after exposure at 5-10% for adults, 15% for adolescents, 24% for one-to-five-year-olds and as high as 43% for infants (Lewis 2007: 146). The disease will normally be evident between one and six months after infection (Lewis 2007: 146). Tuberculosis can affect virtually any part of the skeleton but it predilects the axial skeleton (see Figure 8.13) and particularly the spine, although the major joints are a fairly common site as well (Ortner 2008: 199). Skeletal lesions in tuberculosis tend to be destructive more than formative (Ortner 2008: 199). Vertebral tuberculosis has the primary focus in vertebral bodies and commonly results in kyphosis, creating the classic Pott's deformity and only rarely affects the vertebral arch (Ortner 2008: 199). Cranial vault lesions can occur in the form of small 'corn-sized' granulomas (Jankauskas 1999; Lewis 2004: 86; Teschler-Nicola *et al.* 1998). These tend to originate on the inner table of the vault, providing an important diagnostic feature in differentiating tuberculosis from infectious conditions of the skull, in which the primary focus is the outer table (Ortner 2008: 199).

Figure 8.13: New bone formation on rib from Great Chesterford 106.

Leprosy

Without doubt the period in British history most affected by leprosy was the medieval era (Roberts & Cox 2003: 268). Leprosy is an infection caused by *Mycobacterium leprae* and is contracted via the pulmonary route through droplet infection, and possibly via skin to skin contact (Judd & Roberts 1998: 53; Larsen 1997: 104; Lewis 2002b: 164; Roberts 2000: 150; Roberts & Manchester 2005: 194). Most who acquire the infection have been in prolonged contact with infected individuals, even so leprosy is difficult to contract and some 90% of those infected do not go on to develop the disease (Larsen 1997: 104; Roberts & Cox 2003: 268). An average of at least one-third of the clinical infections manifests the disease during childhood, but there is an incubation period of two to five years after transmission before the presentation of the symptoms and physical signs of the disease (Judd & Roberts 1998: 54; Lewis 2002b: 164; Ortner 2002: 74; Roberts & Manchester 2005: 194). Clinical studies have shown that of all the children born into lepromatous families, 25-50% develop signs of the disease before the age of five years, in many cases, lesions heal spontaneously but may recur when the child is older (Lewis 2008: 175).

Infection with *Mycobacterium leprae* causes disease with a wide clinical spectrum, the presentation depending on the immunological response of the infected individual (Andersen *et al.* 1994: 21; Aufderheide & Rodriguez-Martin 1998: 143; Møller-Christensen 1967: 298; Roberts & Manchester 2005: 195). Direct infection of the soft tissues around the nose and mouth by *Mycobacterium leprae* results in characteristic changes in the facial bones (referred to as rhinomaxillary syndrome). These involve the inflammatory change and/or resorption of the alveolar process of the maxilla causing subsequent antemortem loss of the incisors, anterior nasal spine, margins of the nasal aperture, and the oral and nasal surfaces of the palatine process of the maxilla (Andersen & Manchester 1992: 122; Andersen *et al.* 1994: 27; Aufderheide & Rodriguez-Martin 1998: 144; Møller-Christensen 1967: 297). Other skeletal changes observed in leprosy include inflammatory changes in the bones and joints of the hands and feet, these occur as a result of secondary infection and deformity from the repeated unperceived minor trauma following the peripheral nerve damage (Andersen & Manchester 1987: 77; Andersen *et al.* 1994: 23; Aufderheide & Rodriguez-Martin 1998: 144; Larsen 1997: 104). There also almost always occurs in leprosy an inflammatory reaction of absorption and repair of the distal half to two thirds of the tibia and fibula (Andersen *et al.* 1994: 27; Manchester 2002: 70). However, it is not known whether this periostitis is due directly to pathogenic bacteria or whether it is a biological reaction to local toxicity (Andersen *et al.* 1994: 27).

Treponemal Disease

Three forms of treponematosis affect the skeleton: syphilis, bejel and yaws (Ortner 2008: 205). Yaws and bejel are usually acquired in childhood through transmission via open wounds or sores between an affected child and another child (Ortner 2008: 205). Syphilis is a sexually transmitted disease, and as such the age of onset tends to be in late adolescence or early adulthood (Ortner 2008: 205). It is also possible for syphilis to be transmitted across the placental barrier from the mother to the foetus causing congenital syphilis in the child (Lewis 2007: 151; Ortner 2008: 205). In most cases, toxins released from dead micro-organisms invoke an allergic response and uterine contractions in the syphilitic mother, resulting in foetal death and spontaneous abortion in the first half of the pregnancy (Lewis 2007: 151).

The bone changes of yaws, bajel and syphilis are of osteomyelitis induced by inflammatory reaction to *Treponema* resulting in bone destruction accompanied by extensive bone regeneration (Roberts & Manchester 2005: 208). The diseases differ in the prevalence of bone involvement for whilst all three diseases show involvement of the tibia, multiple bone involvement is frequently noted in syphilis and the skull commonly affected (Roberts & Manchester 2005: 210). There is also a variation in the geographic distribution of the diseases with bejel and yaws being common and endemic in hot climates, although yaws has a predilection for the humid tropics around the equator whereas bejel is prevalent in the arid zones lying north and south of the yaws territory (Roberts & Manchester 2005: 209). Venereal syphilis is widespread, to some extent without geographic frontiers, but with a preference for the crowded urban centres of civilization (Roberts & Manchester 2005: 211).

The distribution of lesions in congenital syphilis is usually symmetrical affecting multiple bones with circumferential profuse new bone formation, which may also involve the calvarium, mimicking porotic hyperostosis (Lewis 2007: 152; Ortner 2008: 208). The bones most commonly affected in late on-set congenital syphilis are the tibia, ulna and radius, flaring scapula and medial clavicle thickening may also be present (Lewis 2007: 154). The abundance of red bone marrow in the fingers can result in dactylitis in the child, and the development of a thin bone shell around the shaft (Lewis 2007: 155). The gummatous lesions developing on the skull follow a different pattern to the sequential formation in adult caries sicca that was outlined by Hackett (1981). Facial changes are also more frequent, with the destruction of the nasal cartilage and surrounding bone resulting in nasal collapse described as saddle nose (Lewis 2007: 155; Ortner 2008: 205). The frequency of bone lesions resulting from congenital syphilis in the general population is rare, reportedly less than 5% of children with documented congenital syphilis (Rothschild & Rothschild 1997: 41). At present, it is the dental stigmata of the disease known as 'Hutchinson's incisors', 'Moon's molars' and 'mulberry molars' that are considered pathognomic of congenital syphilis, but they only become apparent with the eruption of the incisors and first molars around the age of six years (Hillson *et al.* 1998; Lewis 2007: 156).

Small Pox

Smallpox is one of a very few viral infectious pathogens that can affect the human skeleton (Ortner 2008: 209). It only does so when the age of onset occurs during the developmental period and it can only affect the skeleton if the child survives the disease (Ortner 2008: 212). In juvenile smallpox of the skeleton, the bones of the elbow are the predilected site (Ortner 2008: 212). Lesions tend to be bone forming, but this may be accompanied by considerable destructive remodelling (Ortner 2008: 212). The crucial diagnostic factor is that bone involvement is limited to the bones of the elbow in typical cases and tends to be bilateral (Ortner 2008: 212).

Trauma

Trauma can be defined as any bodily injury or wound, this includes fractures, dislocation, disruption of nerve and/or blood supply (Roberts & Manchester 2005: 84). Analysis of the evidence of trauma of an archaeological population can provide information on the lifestyle of the individuals including the economy, living environment, occupation, and interpersonal violence, whereas the state of healing of the injuries may indicate dietary status, the level of medical knowledge, and the occurrence of complications (Roberts & Manchester 2005: 84).

Very few fractures are seen in juveniles from archaeological contexts (Roberts & Manchester 2005: 94). Rather than a low prevalence of injury in the past this is more likely to be due to children's bones healing more rapidly than those of adults because children's bones are more vascular and there is greater osteogenic activity at the interface with the periosteum – the younger the child, the faster a fracture heals (Glencross & Stuart-Macadam 2000: 203; Roberts & Manchester 2005: 94). Childhood injuries that do not completely remodel mainly involve subtle differences in the curvature, alignment, and angulation of bones (Glencross & Stuart-Macadam 2000: 204). However, because these injuries are subtle, they are often not readily apparent to the osteoarchaeologist macroscopically (Glencross & Stuart-Macadam 2000: 204).

Clinical studies have indicated a pattern of injuries that could be suggestive of child abuse. These include fractures to the long bones (metaphyseal, and spiral due to twisting forces), rib fractures (bilateral and close to the spine, and caused by the grasping of the child's chest), skull fractures and widened sutures as a result of subdural haematomas causing pressure inside the skull, and subperiosteal haematomas (and new bone formation) as a result of ripping of the periosteum from the bone if a child is grabbed forcibly and/or swung around (this may also be a result of hitting the child) (Roberts & Manchester 2005: 119). However, the key feature to the recognition of child abuse is the occurrence of injuries in several locations in different stages of healing, which indicates repeated episodes of abuse (Roberts & Manchester 2005: 119).

Birth injury is defined as any condition that adversely affects the foetus during delivery, and may result in brain damage as the result of hypoxia, or mechanical fractures (Lewis 2007: 168). Trauma may result from compression and traction forces during the birth process, abnormal intra-uterine position, difficult prolonged labour, large foetal size, and Caesarean sections (Lewis 2007: 168). Evidence for birth trauma in past populations is, however, scanty, but we may expect to see peri-mortem fractures in the skull of perinates from the medieval period and prior to 1726, when the Chamberlain family secret of birthing forceps was finally revealed (Lewis 2007: 173). Before this time it was the practice of midwives and man-midwives in England to employ a 'crochet' to extract difficult births from the mother where a successful live birth was deemed impossible (Lewis 2007: 173). This implement comprised hooks that would be placed in the orbits and roof of the mouth of the child for extraction (Lewis 2007: 173). If the child was alive before the procedure, they would have certainly died during or shortly afterwards (Lewis 2007: 173). The thin, fragile and fragmentary nature of infant bones may mean that these perimortem crushing injuries are missed and destroyed post-mortem (Lewis 2007: 173).

Conclusion

This chapter has described the large range of possible pathologies that may be observed through the careful examination of subadult skeletal assemblages. It is recognised that most methods of direct infanticide would be virtually undetectable through osteoarchaeological analysis as they do not leave traces on the skeleton. However, the palaeopathological investigation could identify individuals suffering from prolonged periods of stress and from nutritional deficiencies that may be indicative of neglect. When compared with the demographical data in Chapter 10, the morbidity response of the different age and sex categories could provide some suggestion to the role of passive infanticide within the Anglo-Saxon and medieval subadult archaeological populations.

Chapter 9

Materials and Methods

Introduction

The following chapter identifies materials and methods used to conduct this research. It provides the reasoning behind the chosen research area and lists the Anglo-Saxon and medieval burial populations examined for this osteoarchaeological analysis. To justify the chosen methodology, an extensive review is made on the various techniques that could be used to determine the sex and age-at-death of subadult skeletal remains. It compares the advantages and disadvantages of the various age-at-death determination methods appropriate for the age groups analysed, looking at methods based on dental formation, diaphyseal length metrics and development of ossification centres.

A discussion is conducted on the debate surrounding the sex assessment of subadults using osteological remains. This is followed by a review of the subadult sex-assessment techniques reported in the biological anthropological literature, discussing methods of morphological observation and metrical analysis. The controversy surrounding sub-adult sex assessment highlighted the need for tests to analyse the reliability of the proposed sex assessment methods, and the results and conclusions of these tests are presented below. An explanation is then given for the Mortality Rate Ratio, the method that will used to standardise the demographic data from the differently sized archaeological populations.

Materials

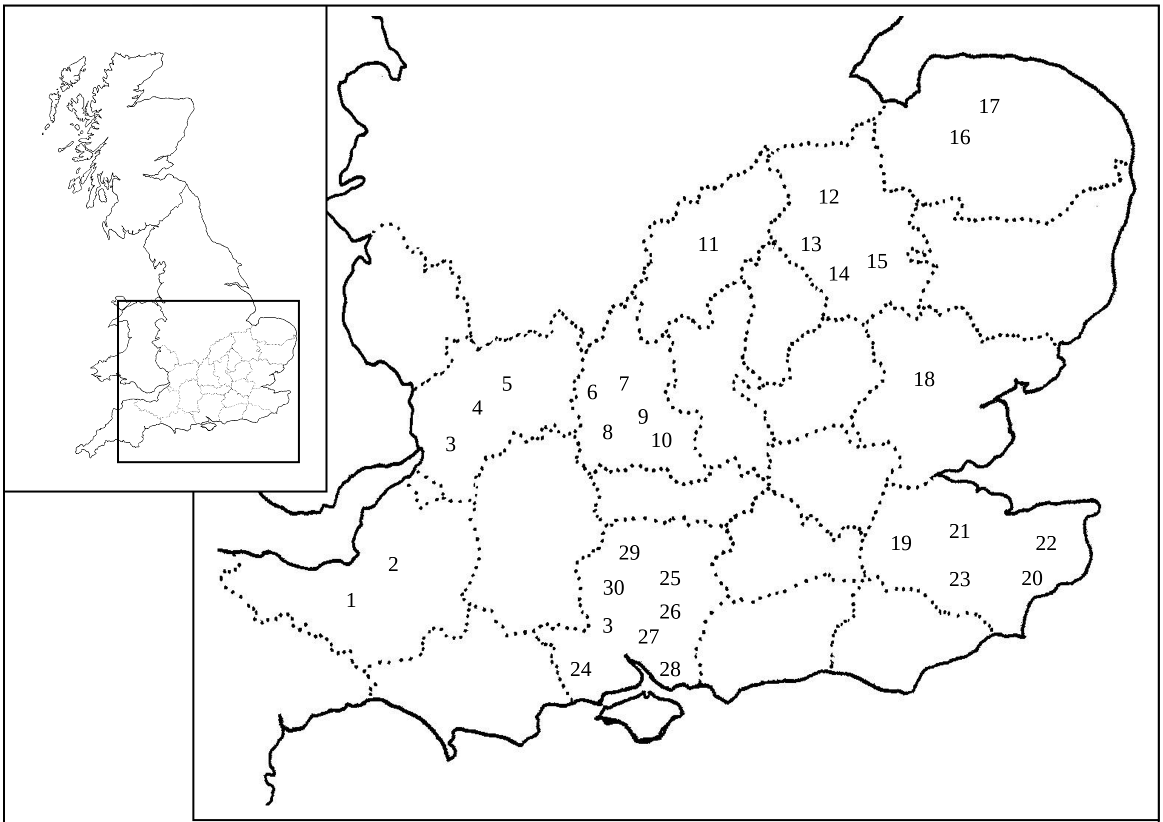
The sites used for this research were selected on the basis of date; the Anglo-Saxon (loosely termed here as c.450-1066 AD) and medieval (1066-1538 AD), geographical location; in this case within southern England, and the presence of individuals under six-years-old within the burial population. Southern England was chosen as a research area in an attempt to analyse sites from a variety of archaeological contexts (both urban and rural) and to include sites that have perhaps received lesser interest from osteoarchaeological observers. The upper age limit of six-years-old-at-death was chosen for this study because this is the age at which the first adult molar begins to erupt and so it is an easily identifiable marker of skeletal maturity often used by osteoarchaeologists.

In the early stages of this research a vast database was complied of over five hundred sites dating from the Anglo-Saxon and medieval periods that have been excavated in southern England (three-quarters of which were from the Anglo-Saxon period alone) mentioned within the archaeological literature. Nevertheless it soon became apparent that many of these sites, particularly those from the Anglo-Saxon period, were early excavations from the late eighteenth and early nineteenth centuries. During these early days of archaeological investigation the principal interest of excavators tended to be the impressive artefact assemblages; the skeletal remains were rarely recorded and very seldom curated. Those early skeletal assemblages that are to be found in museum archives are usually in the form of antiquarian collections of skulls; unfortunately these assemblages only include adult crania and as such are not of any use to this research. Indeed, as we discussed in Chapter 7, the importance of the study of children was long overlooked by archaeologists and the recovery and retention of juvenile skeletons for osteoarchaeological research has only become a common-place practice within the last thirty or so years.

Whilst the priority was to study sites with larger proportions of subadults recovered from the burial record, assemblages with lower subadult representations were also included in this study, to allow for comparison and possible interpretation for the differences of observed mortality profiles. The distributions of the studied sites shown in Figures 9.1 and 9.2 are partly affected by limitations caused by the young age range (0-6 years) of the individuals required for this study; see Chapter 7 for a full discussion on the problems of representation of this age group in archaeological assemblages. However, any archaeological research is determined by our often chance discovery and subsequent excavation of site. This is obviously affected by the choice of location and land use of the archaeological populations under study, and is further affected by any later use of the land with any development or intensive agricultural activity causing destruction to earlier sites. In turn, most archaeological sites discovered in recent decades would not have been uncovered and studied without land development.

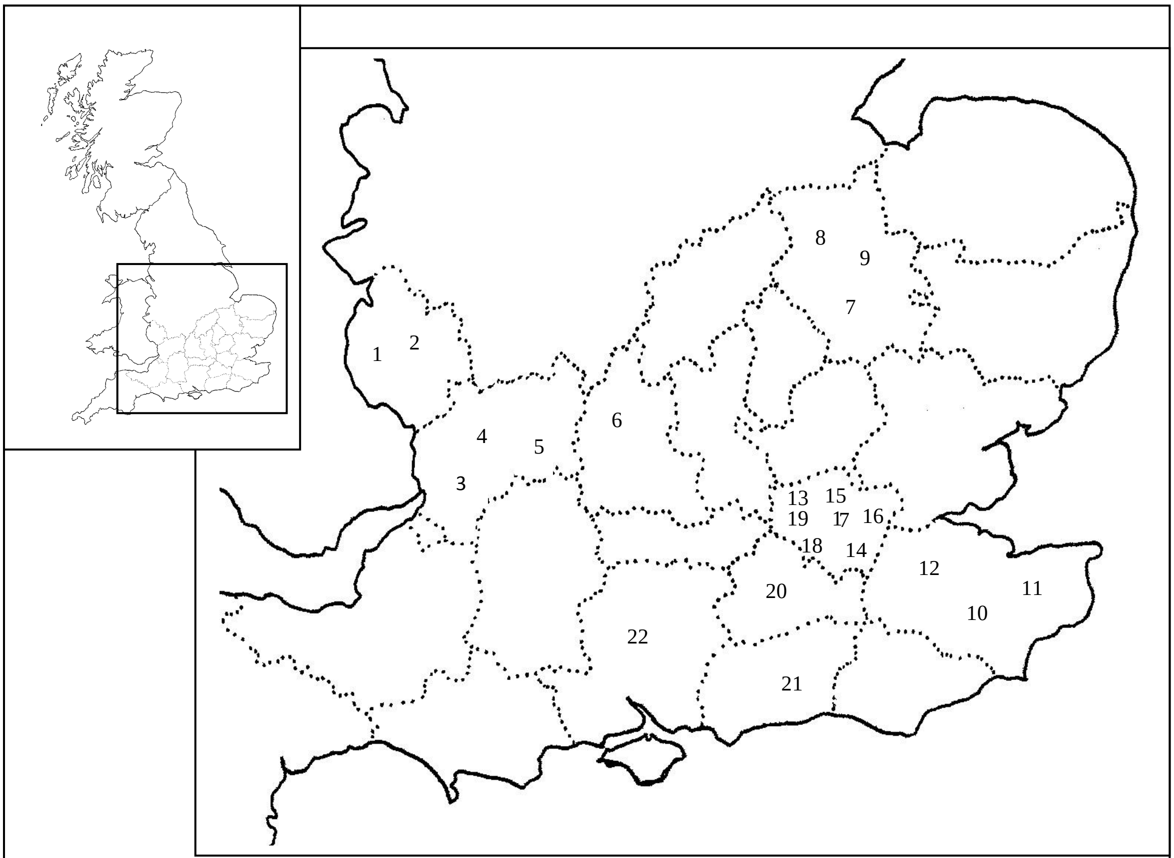
A total of 1275 individuals from fifty-three sites were examined directly by the author for this analysis. This included 817 individuals from thirty-one sites dating to the Anglo-Saxon period and 458 individuals from twenty-two medieval period sites. The studied skeletal assemblages are curated at various institutions across the country including university departments, national museums, local museums, county council archaeological services and archaeological contractors. A short description of each of the sites investigated, including date of excavation, cemetery type, and numbers of individuals analysed is given in Appendices 1 and 2.

The age-at-death and sex of the individual was assessed using both morphological observation and metrical methods outlined below, and the state of preservation was recorded. Descriptions were made of any visible pathological conditions supported by photographs taken by the author. The skeletons had been excavated from a variety of archaeological contexts, having been recovered from both rural and urban locations although with a vast predominance to formal cemeteries. The preservation of the children was found to be highly variable; the extremes can be compared between the excellent condition of the individuals recovered from Stonar, Kent to the extremely fragile nature of those remains from Dover Buckland, Kent. It should also be noted, however, that many of the assemblages reflected a range of bone preservation, rather than a consistent quality throughout the site, although it would appear that this is a common observation from archaeological sites (Henderson 1987: 43).



Site Number	Site Name	County	Date	Studied Individuals	Total Cemetery Population
1	Cannington	Somerset	410-800	97	542
2	Henley Wood	Somerset	410-700	5	75
3	Cirencester Abbey	Gloucestershire	802-1066	2	7
4	Lechlade Butler's Field	Gloucestershire	500-699	33	219
5	St. Oswald's, Gloucester	Gloucestershire	900-1100	12	141
6	Beacon Hill	Oxfordshire	410-660	2	39
7	New Wintles	Oxfordshire	500-799	1	4
8	Queenford Farm	Oxfordshire	430-630	26	164
9	Stanton Harcourt	Oxfordshire	600-699	8	23
10	Watchfield	Oxfordshire	400-500	1	43
11	Raunds	Northamptonshire	500-1066	102	342
12	Barrington Edix Hill	Cambridgeshire	500-65	2	149
13	Burwell	Cambridgeshire	567-699	9	127
14	Cherry Hinton	Cambridgeshire	871-1066	238	683
15	Station Road, Gamlingay	Cambridgeshire	600-699	26	118
16	Norwich North-East Bailey	Norfolk	1000-1075	44	112
17	Redcastle Furze (St Martin's Church Thetford)	Norfolk	410-649	4	85
18	Great Chesterford	Essex	600-700	88	171
19	Bradstow School, Broadstairs	Kent	475-800	6	111
20	Dover Buckland	Kent	467-732	17	444
21	Eccles	Kent	600-800	4	215
22	Finglesham	Kent	500-732	16	243
23	Holborough	Kent	667-699	3	36
24	Alton, Mount Pleasant	Hampshire	410-599	6	47
25	Droxford	Hampshire	467-600	2	41
26	Nunnaminster (St. Mary's Abbey, Winchester)	Hampshire	900-1000	4	4
27	Portway East	Hampshire	467-600	5	69
28	Romsey Abbey	Hampshire	967-1066	10	45
29	Staple Gardens	Hampshire	800-1100	30	288
30	Winnall II	Hampshire	651-700	4	45
31	Worthy Park	Hampshire	450-649	10	96
			Total	817	4728

Figure 9.1: Locations of Studied Anglo-Saxon Sites - represented on the map by the site number.



Number	Site Name	County	Date	Number of Individuals Studied	Total Cemetery Population
1	Hereford Cathedral	Herefordshire	1100-1500	89	1025
2	Leominster	Herefordshire	1300	1	1
3	Cirencester Abbey	Gloucestershire	1200-1300	5	32
4	Gloucester Blackfriars	Gloucestershire	1241-1538	26	129
5	St. Oswald's, Gloucester	Gloucestershire	1153-1536	41	214
6	Eynsham Abbey	Oxfordshire	1066-1538	5	5
7	Clopton	Cambridgeshire	1200-1300	10	10
8	Comet Place	Cambridgeshire	1086-1495	29	29
9	Huntington Orchard Lane	Cambridgeshire	1066-1300	6	51
10	New Romney (St. Martin's Field)	Kent	1300-1530	7	38
11	St Gregory's Priory Canterbury	Kent	1084-1537	8	91
12	Stonar	Kent	1066-1200	45	120
13	East Smithfield	Greater London	1348-1350	52	750
14	Guildhall Yard	Greater London	1050-1150	5	68
15	St Benet Sherehog	Greater London	1066-1666	3	39
16	St. John Clerkenwell	Greater London	1480-1540	1	12
17	St. Mary Graces	Greater London	1349	22	389
18	St Nicholas Shambles	Greater London	1066-1200	10	189
19	Spital Square	Greater London	1197-1538	5	126
20	Cuddington (Nonsuch Palace)	Surrey	1000	23	113
21	Chichester SS James and Mary Magdalene,	Sussex	1118-1621	63	374
22	Market Street, Winchester	Hampshire	1066-1500	2	2
		Total		458	2780

Figure 9.2: Locations of Studied Medieval Sites – represented on the map by the site number.

Methods

Determination of Age-at-Death

Age estimation of subadult skeletons involves establishing the physiological development of the skeleton and correlating this with a chronological age-based reference standard (Chamberlain 2006: 112; Gowland & Chamberlain 2002: 677; Krogman & İşcan 1986: 51). It is extremely important to adopt the criteria relevant to the maturity of the individuals in order to reduce methodological error, this is particularly important with immature individuals (Ferembach *et al.* 1980: 527; Scheuer & Black 2000: 9; Ubelaker 1999: 63). The assessment of the age-at-death of juvenile skeletal remains is further complicated because individuals and populations differ in the rates of development during the growth phase (Anderson 1976: 191; Bass 1999: 12; Steele & Bramblett 1988: 56). The rate of skeletal maturation in populations differs in both the mean skeletal maturity at any given age, and the patterns of increments from age to age (Lampl & Johnston 1996: 352). However, the extent to which the variation between chronological and maturational age may actually occur in skeletal samples is unknown (Lampl & Johnston 1996: 346).

In many populations children are subjected to adverse environmental pressures that can cause a slower rate of growth than their optimum potential (Scheuer & Black 2000: 11; Steele & Bramblett 1988: 8). Of particular significance are the effects of both under-nutrition and exposure to disease, where the occurrence of either exacerbates the effect of the other (Lallo & Rose 1979: 324; Rose *et al.* 1985: 291; Roth 1992). Essential to osteoarchaeological research is the understanding that different diseases may produce similar skeletal changes, and not all are known to induce quantifiable or even recognisable bone change (Eisenberg 1992: 359; Keenleyside 1998: 53; Ortner

1992: 5; Saul & Saul 1989: 289). The absence of pathological lesions is more difficult to interpret, as whilst an impression of better health is created it is possible that individuals with a lack of pathological lesions represent those that died early from the disease (Lewis 2007: 187; Ortner 1998: 82; Wood *et al.* 1992: 365). Conversely, the presence of an inactive lesion indicates survival of a disease process earlier in life and thus may signify an individual whose frailty is low compared with those who died at earlier ages (Wood *et al.* 1992: 252).

It is difficult to be sure that significant age-changes in earlier populations took place at the same time, and that they showed the same group variability as in modern populations (Brothwell 1981: 64). The standards used to assess age-at-death often derive from Western European or North American samples and reflect individuals who are relatively healthy in their particular ecological context and thus show acceleration of growth due to improved nutrition (Ferembach *et al.* 1980: 527; Smith & Avishai 2005: 87). This creates biased samples that may or may not be appropriate for the skeletal group under investigation (Lampl & Johnston 1996: 346; Mays 1985: 216; Pfau & Sciulli 1994: 165), thereby potentially reducing the accuracy of determining the age-at-death of individuals (Krogman & İşcan 1986: 51; Mays 1998: 57; Whittaker 2000: 83). Nevertheless, one should not be deterred from at least trying to estimate the age of juveniles recovered from archaeological sites (Scheuer *et al.* 1980: 263).

Age Estimation from the Dentition

Dental development is generally considered the most accurate method of estimating age-at-death of nonadults (Lewis & Gowland 2007: 120), having several advantages over skeletal age-at-death determinations of juvenile remains (Brothwell 1981: 65;

Ferembach *et al.* 1980: 530; Sundrick 1978: 240). Teeth survive inhumation better than do bones (Scheuer & Black 2000: 12). The growth and development of teeth takes place over almost the whole of the juvenile age range (Saunders *et al.* 1993: 174). Dental age also exhibits less variation than does skeletal age (Moorrees *et al.* 1963b: 213; Scheuer & Black 2000: 13), because it is strongly controlled by genetic factors with minimum influence from the environment (Demirjian 1978: 421; Saunders *et al.* 1993: 173; Smith 1991: 143). However, there are also many factors that can affect eruption and to a lesser degree the calcification of teeth, including premature birth, early extraction of deciduous teeth, crowding, infection and injury (Demirjian *et al.* 1973: 212; Dowling 2005: 21; Redfield 1970: 214; Saunders 1992: 6). Specific diseases, such as hypo-pituitarism and syphilis, can also modify the rate of dental development, although most diseases affect teeth little if at all, even though parts of the skeleton may be greatly altered (Ubelaker 1999: 63).

Tooth Mineralisation

A series of morphological stages are recognisable during tooth maturation, beginning with actual formation of the tooth crypt and ending with closure of the apex of the fully formed root (Liversidge & Molleson 2004: 172; Saunders 1992: 8). The study of tooth formation and dental calcification through examination of loose teeth or radiographs can, therefore, be used to estimate age-at-death (Moorrees *et al.* 1963b: 205; Whittaker 2000: 83). Tooth mineralisation is believed to most closely approximate chronological age, and as such is considered more reliable than tooth eruption (Anderson 1976: 191; Ferembach *et al.* 1980: 530; Smith 1991: 143). Nevertheless, tooth formation is still susceptible to exogenous factors; including diet, stress or socio-economic conditions, and in general the variability of tooth formation has been shown to increase steadily with age (Demirjian 1978: 414; Demirjian *et al.* 1973: 213). In particular vitamins A, C and D have all been shown to have an adverse affect on tooth development if levels decrease enough (Avery 1987: 110). There are further limitations of the published standards for tooth calcification, in the subjectivity in identifying stages such as the difference between the ¼ and ½ calcification of root length (Saunders 1992: 8). It should also be noted that there can be a poor archaeological recovery rate of teeth from very young infants; this is due to the extremely fragile nature of developing tooth crowns, coupled with the fact that they are situated within relatively large crypt spaces in the mandible and maxilla (Chamberlain 2006: 102; Gowland & Chamberlain 2002: 677; Lewis & Gowland 2007: 120).

The most commonly used method to assess the age-at-death of subadults from tooth formation was devised by Moorrees and colleagues (1963a; b), as illustrated in Figure 9.3 and Table 9.1. The method has been further explored by more recent researchers; including Steele and Bramblett (1988: 101) who converted the original data into more user-friendly tables in an attempt to standardise the technique. Smith (1991) altered the original data to allow its use for age prediction, which in a test of age estimation by Liversidge (1994) gave an accuracy within ±0.39 years compared with an accuracy of ±0.62 years gained using Moorrees and colleagues (1963a; b) original data. Using this method shown in Table 9.2, the age for an unknown individual can then be based upon an isolated tooth by examination of its stage of development (Steele & Bramblett 1988: 101). If a complete mandible is available, the ages determined by the development of each tooth should be averaged to increase the reliability of the determination (Moorrees *et al.* 1963b: 205; Steele & Bramblett 1988: 101). If the sex of the unidentified individual is unknown, the age determined from the male and female tables should be averaged (Steele & Bramblett 1988: 101).

This illustration is unavailable due to copyright restrictions.

Figure 9.3: Stages of tooth formation of both deciduous and permanent molars (after Moorrees *et al.* 1963b: 207 Fig 2).

Table 9.1: Definition of tooth mineralisation stages (after Moorrees *et al.* 1963b: 206).

	Coded Symbol
Coalescence of cusps	*Cco*
Cusp outline complete	*Coc*
Crown ½ complete	*Cr½*
Crown ¾ complete	*Cr¾*
Crown complete	*Crc*
Initial root formation	*Ri*
Initial cleft formation	*Cli*
Root length ¼	*R¼*
Root length ½	*R½*
Root length ¾	*R¾*
Root length complete	*Rc*
Apex ½ closed	*A½*
Apical closure complete	*Ac*

Table 9.2: Mean age (in years) for the development stages of the crown and roots of deciduous and permanent mandibular teeth. Data for deciduous teeth from Steel & Bramblett (1988: 102 Table 4.13) includes mean ages ± one standard deviation. Data for the permanent dentition from Smith (1991: 161 Tables 9 & 10).

		Males				Females			
		dm1	dm2	M1	M2	dm1	dm2	M1	M2
Cco	Coalescence of cusps			0.4	4.3			0.5	4.0
Coc	Cusp outline complete			0.8	4.9			0.9	4.5
Cr½	Crown ½ complete	0.2±0.1	0.2±0.1	1.3	5.4	0.2±0.1	0.2±0.1	1.3	5.1
Cr¾	Crown ¾ complete			1.9	6.1			1.8	5.8
Crc	Crown complete	0.5±0.1	0.7±0.1	2.5	6.8	0.4±0.1	0.7±0.1	2.4	6.6
Ri	Initial root formation			3.2	7.6			3.1	7.3
Cli	Initial cleft formation			4.1	8.7			4.0	8.4
R¼	Root length ¼			4.9	9.8			4.8	9.5
R½	Root length ½	1.0±0.1	1.6±0.2	5.5	10.6	0.9±0.2	1.6±0.2	5.4	10.3
R¾	Root length ¾			6.1	11.4			5.8	11.0
Rc	Root length complete	1.4±0.2	2.1±0.4	7.0	12.3	1.4±0.2	2.0±0.2	6.5	11.8
A½	Apex ½ closed			8.5	13.9			7.9	13.5
Ac	Apical closure complete	2.0±0.2	3.1±0.4	9.5±1.0		1.7±0.4	2.7±0.4	8.5±1.2	

Dental Eruption and Formation

The sequence and state of eruption of the teeth has often been recorded for the estimation of age-at-death of subadult skeletal material (Steele & Bramblett 1988: 101). The most widely used standard is that described by Ubelaker (1999) shown in Figure 9.4. The chart combines both dental formation and eruption, and considers the results of many studies on several thousands of individuals (Ferembach *et al.* 1980: 530; Hillson 1996: 142). Following the traditional osteoarchaeological view that sex cannot be estimated reliably from skeletons of subadults, the data for males and females have been combined in Ubelaker's (1999) chart, although it is noted that the canine shows the greatest differential between the sexes (Ubelaker 1999: 64). Each stage of dental development in Ubelaker's chart is accompanied by a plus-and-minus error factor; this expresses most of the variability reported in the literature (Ubelaker 1999: 64).

This illustration is unavailable due to copyright restrictions.

Figure 9.4: Dental development (data from permanent teeth derived from Native Americans) (adapted from Ubelaker 1999: 64 Fig 71; after White & Folken 2005: 366 Figure 19.1).

Neonatal Line

More recent forensic and archaeological analysis on age-at-death estimation of neonates has examined the presence or absence of the neonatal line to assess whether a child was stillborn, or was possibly the victim of infanticide (Lewis & Gowland 2007: 118; Smith & Avishai 2005). Visible as a microscopic hypoplastic defect on the deciduous teeth, the neonatal line is thought to represent a period of enamel stasis after the stress of birth (Smith & Avishai 2005: 84). Since the neonatal line forms a clear delimitation between the extent of prenatal and postnatal crown formation it is independent of gestational age or size at birth (Smith & Avishai 2005: 84). However, as well as the low survival rate of perinatal tooth crowns within archaeological contexts, research on the survivability, location, and visualization of the neonatal line has raised questions about the reliability of this feature in osteoarchaeological investigations (Lewis 2007: 95; Lewis & Gowland 2007: 118). Given the rate of enamel deposition is 4-4.5µm per day, it is also important to note that the neonatal line may only be visualised if the child has survived for up to seven days after birth when the stress or being born has subsided and the enamel resumes its mineralization (Lewis 2007: 95). Furthermore, it is not always possible to carry out destructive analysis on collections held in museums or universities, hindering such investigations on a large scale (Lewis & Gowland 2007: 118), and therefore unpractical for this study.

Age Estimation from the Skeleton

Many centres of ossification, including long bone shafts, develop their own particular changes that may be useful for age estimation, with greater accuracy being obtained from those bone elements that undergo distinct changes within a relatively short time (Scheuer & Black 2000: 15). Due to the stronger effects of environmental influences on developing bones than on teeth (Pfau & Sciulli 1994: 165; Saunders 1992: 11), broader age classifications should be used (Brothwell 1981: 67).

Diaphyseal Length

If approached with appropriate caution, the diaphyses length of long bones can be measured and used for skeletal age estimates from before birth to mid-teens (Ferembach *et al.* 1980: 532; Hoffman 1979: 468), such as the method by Ubelaker (1999: 70-71 Table 14) shown here in Table 9.3. The diaphysis is measured without the associated epiphyses, since the fragile nature of the highly cancellous epiphyses often leads to their erosion and disappearance, either following the skeletalisation of the deceased or through subsequent excavation (Hoffman 1979: 461; Saunders 1992: 11). As with many age estimation methods, there are difficulties in estimating the age-at-death from the length of long bones, and because growth rates vary widely among populations and even among individuals of the same social group the method is often seen as less precise (Ubelaker 1999: 65). Further estimation error is compounded by the fact that most of the data has been recorded from living children, whereas archaeological estimates are made on dry bones (Ubelaker 1999: 65). Studies of growth based on skeletal remains have been confined mainly to archaeological material for which age-at-death has been inferred from the dentition (Scheuer & Black 2000: 13; Ubelaker 1999: 65). Thus, an estimate of age derived from long-bone length not only includes errors resulting from variability in growth, but also the errors incorporated in the original estimates of age based on dentition (Ubelaker 1999: 65). However, the results of Hoffman's (1979) analysis of diaphyseal length measurements show that the age estimations based on long bone lengths are no more variable than those based on dental eruption standards (Hoffman 1979: 468).

Table 9.3: Age-at-death estimation from diaphyseal length measurements (After Ubelaker 1999: 70-71 table 14).

Estimated Age (Years)	Size of Sample	Mean Length (mm)	Standard Deviation	Range of Variation (mm)	Estimated Age (Years)	Size of Sample	Mean Length (mm)	Standard Deviation	Range of Variation (mm)
		Humerus					Femur		
NB-0.5	49	70.5	5.2	63.5-89.0	NB-0.5	51	82.2	8.7	62.5-106.0
0.5-1.5	37	102.3	8.9	84.0-119.0	0.5-1.5	37	126.9	14.6	92.5-161.0
1.5-2.5	11	129.5	5.9	121.0-138.0	1.5-2.5	14	167.1	12.2	141.0-186.0
2.5-3.5	10	139.5	12.8	118.0-157.0	2.5-3.5	9	185.1	20.7	155.0-215.0
3.5-4.5	2	156.5	3.5	154.0-159.0	3.5-4.5	2	213.0	7.1	208.0-218.0
4.5-5.5	4	167.6	8.8	161.0-179.5	4.5-5.5	3	234.3	9.0	225.0-243.0
5.5-6.5	7	180.1	6.5	172.5-192.0	5.5-6.5	8	248.6	14.5	236.0-277.0
6.5-7.5	4	192.1	7.9	187.5-204.0	6.5-7.5	4	262.0	9.2	252.0-272.0
		Radius					Tibia		
NB-0.5	47	57.4	4.9	49.0-73.5	NB-0.5	47	71.6	7.2	59.5-94.0
0.5-1.5	31	81.1	5.1	67.0-92.0	0.5-1.5	30	104.8	11.3	81.0-131.5
1.5-2.5	14	97.1	5.5	84.0-104.0	1.5-2.5	11	138.6	7.8	125.0-151.0
2.5-3.5	9	106.3	9.8	93.5-119.0	2.5-3.5	9	153.8	18.8	127.0-184.0
3.5-4.5	2	118.3	3.2	116.0-120.5	3.5-4.5	2	170.5	7.8	165.0-176.0
4.5-5.5	4	128.1	3.4	125.0-132.5	4.5-5.5	3	190.8	10.3	181.0-201.5
5.5-6.5	5	140.6	5.4	134.5-149.0	5.5-6.5	8	201.6	10.1	191.0-222.0
6.5-7.5	3	149.5	3.5	146.0-153.0	6.5-7.5	4	221.4	7.2	212.0-229.5
		Ulna					Ilium		
NB-0.5	47	66.1	5.0	60.0-82.5	NB-0.5	38	37.0	3.0	32.5-44.5
0.5-1.5	22	92.1	7.7	74.5-103.0	0.5-1.5	34	55.8	4.4	46.0-65.0
1.5-2.5	13	108.5	6.8	94.0-116.0	1.5-2.5	13	69.3	4.5	60.0-74.5
2.5-3.5	9	117.9	10.9	100.0-129.5	2.5-3.5	7	73.4	6.1	64.0-82.0
3.5-4.5	2	129.8	4.6	126.5-133.0	3.5-4.5	2	80.3	1.8	79.0-81.5
4.5-5.5	4	142.8	2.9	140.0-145.5	4.5-5.5	5	83.5	8.3	69.0-89.0
5.5-6.5	6	153.8	7.9	145.0-166.0	5.5-6.5	5	92.8	2.2	90.5-96.0
6.5-7.5	4	167.1	6.1	161.0-175.0	6.5-7.5	4	97.4	1.6	95.0-98.5

Despite being susceptible to greater environmental variability, long bone growth actually provides a more useful index for ageing perinatal infants than does dental development (Hoffman 1979: 468). This is due to the greater preservation of perinatal long bones at archaeological sites and also because the rapidity of growth during this period of skeletal development results in large differences in bone size between age categories (Chamberlain 2006: 101; Gowland & Chamberlain 2002: 677; Lewis & Gowland 2007: 120). Errors in the relationship between diaphyseal lengths and gestational age are well known, but difficult to control for in archaeological populations (Craig 2006: 29; Lewis 2007: 43; Sherwood *et al.* 2000: 305; Ubelaker 1999: 65). In addition to factors pertaining directly to the mother, such as her nutritional status, ethnic group, age, height, and parity, external factors such as season, social class, and pollutants have all been shown to affect the size and weight of the infant at birth and hence the length of the diaphyses (Lewis & Gowland 2007: 120; Scheuer *et al.* 1980: 263; Smith & Avishai 2005: 83). It has also been proposed that female foetuses mature earlier than do males in terms of both leg length and weight (Lampl & Jeanty 2003), potentially resulting in longer diaphyseal lengths, and hence, older age estimates in female dominated samples (Lewis 2007: 43). However, research by Sherwood and colleagues (2000) indicated that foetal sex also showed no significant influence on growth of foetuses; therefore a combined sex sample was used in all analyses.

Care should, however, be taken when attempting to age a perinatal infant with a known, or suspected, pathology as research by Sherwood and colleagues (2000) indicated that gestational age estimates based on diaphyseal measurements of pathological individuals were often inaccurate. For some pathological conditions there is a considerable bias tendency to overage, for example, for both anencephalics and spina bifida cystica cases, some limb measurements were characterized by levels of inaccuracy exceeding three weeks (Sherwood *et al.* 2000: 311). A further consideration when examining the age-at-death of perinatal infants, is that premature birth is not archaeologically visible; this means among other things that infant remains may mistakenly be described as foetal if they represent low birth weight infants who were born alive, but died in the perinatal period (Smith & Avishai 2005: 83). Discrimination between stillborn infants and those dying later is important both for forensic cases and for palaeoepidemiological studies (Smith & Avishai 2005: 83). It also provides the means of interpreting attitudes of past societies to infant death as expressed in funerary practices (Smith & Avishai 2005: 83).

The most commonly used method for ageing perinatal skeletons is the regression method produced by Scheuer, Musgrave and Evans (1980). This method allows gestational age (from the first day of the last menstrual period) of perinatal infants to be estimated to within about two weeks using long bone lengths (Mays 1993: 884). The average length of gestation is 40 weeks but there is some variation about this mean with the limits of normal gestation being 38-41 weeks (Mays 1993: 884; Molleson 2003: 120). The Scheuer *et al.* (1980) regression models for perinatal age estimation is based on; (i) the lengths of the ossified shafts of the femur, tibia, humerus, radius and ulna of 29 male and 36 female foetuses age between 24 and 40 weeks from The London University Institute of Child Health data (ICH data) see Table 9.4, and (ii) the ossified shafts of the femur humerus and radius of 17 foetuses and neonates of mixed sex aged between 27 and 46 weeks from The Bristol Royal Hospital for Sick Children (BCH data) see Table 9.5 (Scheuer *et al.* 1980: 258).

Table 9.4: Regression models of age-at-death estimation from foetal diaphyseal lengths based on ICH data (After Scheuer *et al.* 1980: 260 table 1).

Method Number	Method	Regression equation	A	B	C
1.01	Multiple linear regression	$\left.\begin{array}{r} +0.1724\ \mathrm{FEM} \\ +0.1538\ \mathrm{TIB} \\ +0.0674\ \mathrm{HUM} \\ -0.0718\ \mathrm{RAD} \\ +0.1397\ \mathrm{ULN} \end{array}\right\} + 7.2624$	1.88		0.83
1.02	Multiple linear regression	$\left.\begin{array}{r} +0.1984\ \mathrm{FEM} \\ +0.2291\ \mathrm{TIB} \end{array}\right\} + 9.3575$	1.87		0.82
1.03	Multiple linear regression	$\left.\begin{array}{r} +0.1970\ \mathrm{HUM} \\ +0.0557\ \mathrm{RAD} \\ +0.3033\ \mathrm{ULN} \end{array}\right\} + 4.8817$	2.12		0.77
1.04	Femur linear regression	+0.3303 FEM + 13.5583	2.08	0.78	
1.06	Tibia linear regression	+0.4207 TIB + 11.4724	2.12	0.76	
1.08	Humerus linear regression	+0.4585 HUM + 8.6563	2.33	0.71	
1.10	Radius linear regression	+0.5850 RAD + 7.7100	2.29	0.72	
1.12	Ulna linear regression	+0.5072 ULN + 7.8208	2.20	0.74	

Table 9.5: Regression models of age-at-death estimation from foetal diaphyseal lengths based on BCH data (After Scheuer *et al.* 1980: 262 table 4).

Method Number	Method	Regression equation	A	B
4.01	Femur linear regression	+0.3922 FEM + 8.8300	1.49	0.95
4.03	Humerus linear regression	+0.5524 HUM + 2.7825	1.24	0.97
4.05	Radius linear regression	+0.7622 RAD – 0.9181	1.97	0.92

Sherwood and colleagues (2000) also created regression models for perinatal age estimation using a much larger control group of 72 foetuses between 15 and 42 weeks of gestational age, see Table 9.6. A full evaluation including radiographic, karyotypic, gross anatomic, and histologic examination of the foetus and placenta identified the 72 individuals as nondysmorphic with no signs of chronic uterovascular insufficiency (Sherwood *et al.* 2000: 305). These foetuses were primarily spontaneous abortions resulting from intrauterine infection or acute placental-cord compromise (Sherwood *et al.* 2000: 306). Gestational age for all foetuses was based on accurate reports of the mother's last normal menstrual period (Sherwood *et al.* 2000: 306).

Table 9.6: Regression models for foetal age-at-death determination based on long bone length (After Sherwood *et al.* 2000: 309 table 1).

Model: Gestational Age (weeks) = a + b_1x + b_2x^2

Variable	n	r	$S_{(y:x)}$	a	b_1	b_2
Femur length (mm)	63	0.96	2.05	10.91	0.38	
Tibia length (mm)	61	0.96	2.06	15.13	0.19	3.1E-03
Ulna length (mm)	62	0.96	2.08	14.28	0.19	3.9E-03
Humerus length (mm)	65	0.96	2.12	12.98	0.25	2.4E-03
Radius length (mm)	63	0.96	2.14	13.53	0.25	4.5E-03

Many authors have suggested that regression equations can introduce a systematic statistical bias in the estimation of age from the skeleton (Aykroyd *et al.* 1997; Bocquet-Appel & Masset 1982; Chamberlain 2000a: 107; Chamberlain 2006: 113; Gowland & Chamberlain 2003: 43; Lewis & Gowland 2007). Gowland and Chamberlain (2002: 120) argued against the use of regression equations because the estimated ages in the 'target' population (the archaeological population of unknown age) 'mimics' the distribution of the reference sample (the skeletal population of known aged individuals upon which the ageing method was devised). However, Mays (2003b) investigated the claims made by Gowland and Chamberlain (2002) that the neonatal peak observed in the Roman data by Mays (1993) was simply an artefact of 'age-structure mimicry' of the age distribution of Scheuer *et al.*'s (1980) reference sample. Mays (2003b) chose to re-age the Roman material using regression equations derived from Sherwood *et al.* (2000) because their reference sample has a very different age structure to that of Scheuer and colleagues' (1980) BCH material that had been used in the original Mays (1993) study. Mays's (2003b: 1696) re-analysis of the data using Sherwood and colleagues' (2000) equations made little difference to the overall shapes of the two distributions; the Romano-British data still show a pronounced peak at around full term (38–41 weeks gestation), whereas the medieval data are flatter. The pattern in the Roman data, whether aged using the Scheuer and colleagues' (1980) or the Sherwood and colleagues' (2000) equations, resembles closely the gestational age distribution of modern live births (Mays 2003b: 1696). The above results demonstrate that the peak Mays (1993) observed in the Roman data is not an artefact of using the Scheuer and colleagues (1980) regression equations for age estimation (Mays 2003b: 1696).

Recent work in palaeodemography has emphasized the utility of Bayesian inference in age-at-death estimation of skeletal populations (Gowland & Chamberlain 2003: 44; Lewis & Gowland 2007: 120). Bayesian data analysis allows us to make inferences from data using probability models for observable quantities (known age data) and for quantities that are unknown (archaeological data), but that we wish to learn about (Lewis & Gowland 2007: 120). Gowland and Chamberlain (2002) attempted to compensate for the innate variation in age estimations based on long bone length by using Bayesian probability theory based on model life tables of natural perinatal mortality. The Bayesian technique does not assign all individuals with the same long bone length to the same gestational age (as the regression technique does), instead it takes into account the fact that individuals with the same long bone length may fall within a range of gestational ages (Lewis & Gowland 2007: 127). It does this by incorporating a probability distribution of gestational age given the long bone length based on observations of a large sample of known age data; in this case the 1958 Perinatal Mortality Survey (Butler & Alberman 1969) of all 17,000 newborns dying within a one week period in England and Scotland (estimated 98% of all births) (Gowland & Chamberlain 2003: 46; Lewis & Gowland 2007: 122). Therefore, while this technique does not provide ages for individuals, it does generate a probability distribution of gestational ages from the observed long bone lengths (Lewis & Gowland 2007: 127). However, Mays (2003b: 1699) highlighted potential problems with Gowland and Chamberlain's (2002) reference samples which undermine the validity of the method, although Chamberlain (2006: 123) has since further defended the method stating that the five-millimetre size categories compensates for any alleged high dispersion.

Development of Primary Ossification Centres

For skeletons of very immature individuals the ossification sequence of the occipital bone can be used for approximate age estimation (Brothwell 1981: 65; Buikstra & Ubelaker 1994: 42; Redfield 1970: 219). The occipital comprises of four primary ossification centres; two *pars lateralis*, the *pars squama*, and the *pars basilaris*

(Redfield 1970: 207). Studies by Scheuer and Maclaughlin-Black (1994) and Tocheri and Molto (2002) indicate that measurements of the maximum length (ML), sagittal length (SL) and maximum width (W) of the *pars basilaris* enabled an estimation of the age of the foetus or infant (see Figure 9.5 for details of the measurements). Research by Tocheri and Molto (2002) suggests that; A. If SL equals or exceeds W, the individual is likely to be younger than 32 foetal weeks or eight lunar months. B. If W exceeds SL but not ML, the individual is likely to be older than 32 foetal weeks or eight lunar months but less than six months postpartum. C. If W equals or exceeds ML, the individual is likely to be six months of age or older (Tocheri & Molto 2002: 360). This bone is particularly useful in the age assessment of foetal remains because its compact and robust structure means it is often recovered intact (Lewis 2007: 44; Scheuer & MacLaughlin-Black 1994: 377).

This illustration is unavailable due to copyright restrictions.

Figure 9.5: Basiocciput osteometrics (after Scheuer & Black 2004: 75 Fig 4.20).

The *partes laterales* can enable the estimation of age-at-death for infant remains as during the first year the bone posterior to the foramen magnum extends laterally to form the quadrangular jugular process (Scheuer & Black 2004: 72). Between the ages of one and four years the condylar limb and the jugular limb of the *pars lateralis* fuse to form the hypoglossal canal (Scheuer & Black 2004: 72), as pictured in Figure 9.6. The *partes laterales* fuse with the supra-occipital part of the *pars squama* between the first and third years at the sutura intra-occipitalis posterior (Buikstra & Ubelaker 1994: 42; Ferembach *et al.* 1980: 530; Scheuer & Black 2004: 76). Complete fusion of the *partes laterales* with the *pars basilaris* at the sutura intra-occipitalis anterior takes place between the ages of five and seven, but can start as early as three years (Scheuer & Black 2004: 76). The occipital becomes a single bone during the first six years of life (Gray & Carter 2003: 23; Redfield 1970: 207; Scheuer & MacLaughlin-Black 1994: 377).

This illustration is unavailable due to copyright restrictions

Figure 9.6: Formation of the hypoglossal canal of the *pars lateralis* (From Scheuer & Black 2004: 73 Fig 4.18).

The development of the temporal bone can provide an age estimate from foetal to two-and-a-half-years through observation of the fusion of the tympanic ring and development of the tympanic plate in childhood (Scheuer & Black 2004: 91), as is illustrated in Figure 9.7. However, it should be noted that age estimation has been found to be more practical and useful when taken from the occipital bone (Krogman & İşcan 1986: 109).

This illustration is unavailable due to copyright restrictions.

Figure 9.7: The formation of the tympanic plate: (a) birth, (b) 6 months, (c) 1 year, (d) 2.5 years (From Scheuer & Black 2004: 91 Fig 4.31).

The sphenoid can also be cautiously used for age estimation in young juvenile ageing, although its fusion can be more variable than other bones (Scheuer & Black 2004: 100). The more common pattern of fusion of the sphenoid is as follows: at birth the body with lesser wings attached are separate from the greater wings which fuse within the first year, at which time the foramen spinosum is also complete (Scheuer & Black 2004: 13). Whilst at birth the frontal bone consists of two parts, the metopic suture is normally closed between years two and four, although in some individuals it is retained into adult life (Ferembach *et al.* 1980: 530; Gray & Carter 2003: 28; Scheuer & Black 2004: 111). The mandible fuses at the symphysis during year one (Ferembach *et al.* 1980: 530; Scheuer & Black 2004: 141; Steele & Bramblett 1988: 56).

The vertebral column has a series of growth events that make it useful in estimating the age-at-death of unknown individuals (Steele & Bramblett 1988: 132) as is represented in Figure 9.8. During the first year of post-natal life the neural arches commence fusion posteriorly at the spinous process, this occurs initially in the lower thoracic and upper lumbar regions and progresses in a systematic cranial and caudial direction so that the cervical arches may not fuse until the beginning of the second year and the lowest lumbar may not fuse until the end of the fifth year (Scheuer & Black 2004: 193). Fusion of the neural arches and the centra at the neurocentral junction tends to occur first in the lumbar region, followed closely by the cervical segment, with the thoracic vertebrae generally being the last to close (Scheuer & Black 2004: 194).

This illustration is unavailable due to copyright restrictions.

Figure 9.8: Sequence of vertebral development (From Buikstra & Ubelaker 1994: 42 Fig 18).

Summary of Age Estimation Methods

This review has indicated the importance of selecting the most suitable age-at-death estimation method for the age of the individual. In this study the perinatal individuals will be aged using long bone growth as it is considered a more accurate measurement in the age-at-death determination for this age category. As it has been clearly demonstrated by Mays (2003b) that age-at-death estimation of perinatal individuals by regression equations does not cause ‘age-structure-mimicry’, and given the ongoing dispute regarding the validity of Bayesian age-at-death estimation, it was decided to estimate the age-at-death of the perinatal individuals using the ICH data regression technique from Scheuer and colleagues (1980). Although it is an osteological convention to use measurements from only the left side of the body (unless damaged or absent), in this study measurements were taken from both the left and right sides, using sliding calipers, and then averaged. This was done in an attempt to reduce any bias caused by either morphological asymmetry (which can be observed even in foetal individuals), or taphonomic abrasion which particularly in the younger children is not always immediately apparent due to their small size.

In the age-at-death estimation of older subadults, dental development takes precedence, with diaphyseal length being used for those individuals where dentition was not present. Dental descriptions were recorded using the original descriptions provided by Moorrees and colleagues (1963b: 206) and Ubelaker (1999: 64). If neither dentition nor any long bones are recovered the development of other primary ossification centres were recorded for that individual. The age categories used for this study are shown in Table 9.7 these are based on the categories used by the Biological Anthropology Research Centre but with greater sub-division within the Young Child category to allow for more detailed data comparisons. So that they may be utilised by future researchers the recorded diaphyseal measurements for each individual are provided in File 1 on the CD.

Table 9.7: Skeletal age definitions based on BARC age categories.

Skeletal Age Categories	
Foetal	< 40 weeks
Neonate	*ca*. 40 weeks (birth) – 1 month
Infant	1 month – 1 year
Young Child	1 – 2 years 2 – 3 years 3 – 4 years 4 – 5 years 5 – 6 years

Sex Assessment

The question of the existence of prepubertal sex differences in skeletal morphology has been a subject of considerable controversy (Hunt 1990: 881; Reynolds 1945: 322). It has often been assumed in the archaeological literature that skeletal morphological differences between the sexes do not reach a high enough level for reliable determination of sex until after the pubertal modifications have taken place (Ferembach *et al.* 1980: 517; Genovés 1970: 433; Redfield 1970: 213; Saunders 1992: 6; Scheuer & Black 2000: 12). However, studies as early as those by Verneau (1875), Fehling (1876) and Thomson (1899) reported recognisable sex differences existing in the infant and foetal skeleton. Indeed, it is well known that normal humans are genetically male or female from the moment of conception, and endocrine influences are active enough during the foetal period to differentiate secondary and tertiary sexual characteristics (Loth & Henneberg 2001: 179). Testicular androgens are largely responsible for observed sex differences in the human skeleton (Sutter 2003: 928). Foetal testosterone is reported to be present as early as the tenth week of foetal development and peaks during the fifteenth week of foetal development (Sutter 2003: 928). Perinatal infants can be particularly diagnostic as sexual dimorphism at birth is somewhat magnified because of the influence of prenatal testosterone concentration in foetal males, which peaks around the time of prenatal sexual differentiation then decreases throughout childhood until just before puberty (Saunders & Barrans 1999: 190; Thomson 1899: 380; Weaver 1980: 192).

More recent endocrine studies confirming that there are periods of development, both prenatally and during the first year of life, that are characterized by the production of near-adult levels of sex hormones (Loth & Henneberg 2001: 180).

However, the age of onset and quantity of androgen production will influence the expression of skeletal indicators of sex for foetal and juvenile skeletal remains (Sutter 2003: 928). The onset and quantity of androgen production is influenced by a variety of factors including genetics, development, and foetal environment, and slight differences in the timing and quantity of foetal testosterone may result in dramatic differences in both the degree and rate of a sexually dimorphic trait's expression (Sutter 2003: 928). These factors may differ from population to population, therefore, subadult sexing techniques that may be of value for one population may not be of value when applied to others (Sutter 2003: 928).

Morphological Sex Assessment

Developing and testing methods of subadult sex assessment has proven problematic for a number of reasons, most of which can be traced to the lack of suitable skeletal samples of known sex, and of ages that are equally distributed throughout foetal, infant, childhood, and adolescent periods (Hunt 1990: 881; Rogers 2009: 143). However, Schutkowski (1993) provides a morphological method of sex assessment of infant and juvenile skeletons based on the sexually distinctive traits of the mandible and ilium. Schutkowski's (1993) method is based on a sample of 61 children (37 boys, 24 girls) of known sex and age from Christ Church Spitalfields, London. Three traits of the mandible are identified: the protrusion of the chin region, the shape of the anterior dental arcade, and the eversion of the gonion region (Schutkowski 1993: 200), see Figure 9.9. Four traits of the ilium are described: angle of the greater sciatic notch, depth of the greater sciatic notch, the 'arch' criterion, and the curvature of the iliac crest (Schutkowski 1993: 201), see Figure 9.10. Schutkowski (1993) identified that whilst the selected traits of the mandible clearly distinguish male individuals, they fail to allocate girls reliably (Schutkowski 1993: 202). In the case of the ilium the morphognositc traits studied revealed a clear sexual dimorphism between boys and girls (Schutkowski 1993: 202). The traits connected with the greater sciatic notch are the best discriminators: 95% of the individuals with a narrow notch were boys, whereas 71.4% of those with a wider sciatic notch were girls (Schutkowski 1993: 202). The criterion 'depth of the greater sciatic notch' correctly allocated 81.2% of boys (deep notch) and 76.5% of girls (shallow notch) (Schutkowski 1993: 203). Thus the basis for a sexual determination of immature skeletal individuals is provided with a diagnostic accuracy comparable to that known for adult individuals (Schutkowski 1993: 204).

This illustration is unavailable due to copyright restrictions.

Figure 9.9: Morphological sex assessment of the mandible

a. Protrusion of the chin
b. Shape of the anterior dental arcade
c. Eversion of the gonion region (From Schutkowski 1993: 200).

This illustration is unavailable due to copyright restrictions.

Figure 9.10: Morphological sex assessment of the ilium

a. Angle of the greater sciatic notch
b. "Arch" criterion
c. Depth of the greater sciatic notch
d. Curvature of the iliac crest (from Schutkowski 1993: 201)

Loth (1996) conducted the first test of Schutkowski's (1993) criteria of the mandible (Loth & Henneberg 2001: 180). The results were poor; accuracy was only 33% for chin protrusion and 37% for gonial eversion, whilst dental arcade shape could not be differentiated at all (Loth & Henneberg 2001: 180). The vast majority of mandibles were not bilaterally everted, regardless of sex (Loth & Henneberg 2001: 180). This trait also showed significant population differences in expression, suggesting that it is autosomal rather than sex-linked (Loth & Henneberg 2001: 180). It appears that gonial form is associated both with facial architecture and the relative balance of the masseter and medial pterygoid (Loth & Henneberg 2001: 180). Loth & Henneberg (2001) provide their own morphological sex assessment method of the subadult mandible based on 62 juvenile mandibles of white and black South Africans from the Dart Collection, for which they report a predictive accuracy of 81% (Loth & Henneberg 2001: 182). However, when this method was later blind tested on a sample of known sex and age from the Christ Church Spitalfields collection by Scheuer (2002), the overall percentage accuracy in sex assessment of the mandible was lower at only 64%. The tests also showed that: 1) the method sexed males more reliably than females;

and 2) consistency was low (Scheuer 2002: 189). Scheuer (2002: 191) also highlighted that the previous studies by Molleson and colleagues (1998) and Schutkowski (1993) of sexing from juvenile mandibles indicate that male juveniles are more accurately sexed than females. Whilst this may indicate a problem with the Christ Church Spitalfields juvenile sample in that it contains a low proportion of females, which would tend toward a bias for correct identification of males, the sample of Loth and Henneberg (2001) also showed a much higher accuracy in the identification of males (Scheuer 2002: 191). Indeed, the majority of the sex assessment methods reportedly over-represent male, not female, subadults (Rogers 2009: 143), however, this is a phenomenon equally observed for sex assessment of adult skeletons (Loth & Henneberg 2001: 182; Power 2007: 19; Scheuer 2002: 189).

Sutter's (2003) study further tested Schutkowski's (1993) morphological sex assessment methods using the autopsied skeletal remains of 85 pre-Colombian subadult mummies of known-sex from the Atacama Desert Region of northern Chile (Sutter 2003: 927). With the exception of gonial eversion, all of the traits produced statistically significant values for their associations with known sex when all subadult remains were considered (Sutter 2003: 927). However, only four of the traits, all from Schutkowski (1993), demonstrated the 75% accuracy suggested by De Vito and Saunders (1990) as the arbitrary minimum standard for acceptability for any given sexing trait for forensic and bioarchaeological applications (Sutter 2003: 928). These traits include the arch criterion (82.3%), angle of the sciatic notch (80.7%), depth of the sciatic notch (79.0%), and mandibular-arcade shape (77.6%) (Sutter 2003: 927).

For subadults ranging in age from newborn to five skeletal years of age, only depth of the sciatic notch (81.5%) and the arch criterion (81.5%) approach acceptable levels for use in forensic cases (Sutter 2003: 927). Sutter's (2003) analysis indicated that the skeletal traits are less accurate when applied to newborn to one-year-olds from the known-sex subadult sample from northern Chile, but are generally more accurate for prehistoric subadult Chileans of known-sex between two to five skeletal years of age (Sutter 2003: 934). Among subadults of the youngest age class (newborn to one year of age), greater sciatic notch depth and mandibular protrusion are the most valuable among the eight characteristics for the sample reported by this study (Sutter 2003: 933). While Schutkowski's (1993) data indicate the greater sciatic notch (77.3%) and arch criteria (76.2%) marginally surpass the minimal standard of accuracy use in forensic cases for infants under two (Sutter 2003: 934).

More recently Schutkowski's (1993) method for juvenile sex assessment was evaluated by Vlak and colleagues (2008). This examined the morphology of the greater sciatic notch of 56 ilia (23 females and 33 males) from a documented skeletal collection housed at the Bocage Museum in Lisbon (Portugal) (Vlak *et al.* 2008: 1). Inconsistent with previous studies (Schutkowski 1993; Sutter 2003), the results of our application of Schutkowski's (1993) method to the juveniles from the Lisbon collection revealed only a marginal level of sexual dimorphism in greater sciatic notch morphology (Vlak *et al.* 2008: 5). It is suggested that this may not be the result of sexual dimorphism itself, but is instead a product of investigator subjectivity in trait scoring (Vlak *et al.* 2008: 5). Furthermore, Vlak and colleagues (2008: 5) propose the possibility that morphology of the greater sciatic notch is subject to substantial alterations during ontogeny, and cannot be used for sex assessment in juveniles, arguing that substantial overlap of female and male distributions of age-adjusted measures of greater sciatic notch morphology preclude their use as reliable indicators of juvenile sex in all populations.

Both the studies by Schutkowski (1993) and Sutter (2003) indicate that morphological traits can, with caution, reliably be used to determine the sex of subadults with diagnostic accuracy comparable to that known for adult individuals (Schutkowski 1993: 204). Whilst it has been shown that there are differences in the reported accuracy of Schutkowski's (1993) morphological sex assessment method within the literature, it is unclear as to whether this is the result of population variation or intra-observer error. Similar inconsistency is also observed in the re-examination of morphological sex assessment methods of adults. For example, White and Folken (1999: 368) report discrepancies between two major tests of the Phenice (1969) technique, often regarded as the most reliable of adult sex assessment methods. Schutkowski's (1993) method for sex assessment allows rapid evaluation of morphological features and is applicable even in cases where preservation does not allow measurements to be taken (Vlak *et al.* 2008: 1).

Metrical Sex Assessment

Metrical sexing techniques are objective, repeatable, and easily taught, and therefore can be more accurate; however, metric analyses are also population specific, and the use of inappropriate comparative data can reduce the accuracy (Buikstra & Ubelaker 1994: 16; Saunders & Yang 1999: 38; Walsh-Haney *et al.* 1999: 28). While recent metric techniques for identifying sex-based differences in skeletal morphology have shown promise, metric measurements of foetal and subadult skeletal elements have generally been found to be of more limited use for the correct assignment of foetal and subadult sex (Sutter 2003: 927). This may be due, in part, to an inability to identify or reproduce useful metric measurements (Holcomb & Konigsberg 1995: 121; Sutter 2003: 927). Earlier metrical methods based on nonarticulated ilia met with difficulties in locating anatomical landmarks (Vlak *et al.* 2008: 1). A further serious methodological issue was an apparent inability to account for influences from other sources of variation such as age, population affiliation, health, or environmental factors (Rösing 1983: 150; Vlak *et al.* 2008: 1; White & Folken 2005: 392). There are, however, metrical sex assessment methods of subadults that provide clear defined skeletal landmarks for measurement such as that of Schutkowski (1987), see Figure 9.11. Furthermore, the discriminant functions of the ilium and femur described by Schutkowski (1987) and (1990) provide a certainty of classification ranging from 63.2% to 71.1% and 81.5% to 85.2 % respectively, see Tables 9.8 & 9.9 and Figure 9.12.

This illustration is unavailable due to copyright restrictions.

Figure 9.11: Metrical Sex assessment of the Ilium and Femur

A. Measurements of the greater sciatic notch taken from the dorsal aspect of the ilium.
B. Ilium length and breadth, measured on the ventral aspect of the ilium.
C. Length of the femur.

(after Schutkowski 1987: 348-9)

Table 9.8: Discriminant functions for the foetal and neonatal ilium and femur (After Schutkowski 1987: 351 table 2).

Indices Description:
V1 = Sciatic notch depth / Width
V2 = Sciatic notch width / Ilium length
V3 = Sciatic notch width / Femur length
V4 = Sciatic notch depth / Ilium length
V5 = Sciatic notch depth / Femur length
V6 = Ilium breadth / Ilium length
V7 = Ilium length / Femur length

Indices	Function No					
	1	2	3	4	5	6
V1	0.2040	0.2007		0.2059	0.4024	0.1182
V2						0.7989
V3			-0.4374			-1.9392
V4					-0.6691	-2.6562
V5			1.4523			6.1651
V6		-0.0705	-0.0683	-0.0848	-0.0795	
V7				-0.1284		
Constant	-6.2994	-0.1568	5.7623	6.8288	-6.4565	-2.5246
Group mean male	0.3854	0.4064	0.4012	0.4127	0.4156	0.4144
Sectioning point	0	0	0	0	0	0
Group mean female	-0.6320	-0.6665	-0.6580	-0.6769	-0.6816	-0.6796
Certainty of classification male	60.0	65.0	70.0	65.0	55.0	75.0
Certainty of classification female	66.7	77.8	72.2	66.7	72.2	66.7
Total certainty of classification	63.2	71.1	71.1	65.8	63.2	71.1
P	.0002	.0004	.0018	.0012	.0032	.0078

Table 9.9: Os Ilium Discriminant Functions (From Schutkowski 1990).

	Os ilium DF 1	**Os ilium DF 5**
GSN width / GSN depth		-0.01227
GSN width / Ilium width	2.519899	-0.07466
GSN width / Ilium height	-2.35881	
Ilium width / GSN depth	-0.00327	
Ilium width / Ilium height	0.63066	
Constant	-62.76045	7.13506
Mean males	0.80568	0.49569
Sectioning point	0	0
Mean females	-1.17191	-0.72100
Accuracy males	90.6	84.4
Accuracy females	77.3	77.3
Accuracy total	85.2	81.5

Sciatic notch index (width / depth)

Males: 3.57 ± 0.58 <2.99 is definitely male

Females: 4.33 ± 0.85 >5.18 is definitely female

Figure 9.12: Sciatic Notch Index (Schutkowski 1990).

DNA Sex Assessment

It is now possible to ascertain the sex of an archaeological skeleton by extracting and amplifying genomic DNA using an amplification method such as polymerase chain reaction (PCR) (Waldron *et al.* 1999: 71). There are limitations to DNA sex assessment; firstly the relative expense of this method precludes its use for most archaeological applications, particularly when PCR relies on the survival of DNA in sufficient quantities and in a form suitable for amplification (Waldron *et al.* 1999: 71). There have been recent attempts to use DNA sex assessment to address the possibility that preferential female infanticide was practiced within Roman contexts. Mays and Faerman (2001) performed DNA-based sex identification on 31 infants from Thistleton and Ancaster, however, sex identification was achieved in only thirteen individuals (Mays & Faerman 2001: 556). Similarly of the seven Roman infants from Sussex examined by Waldron and colleagues (1999) only four infants were able to be sexed, and out of 43 femora tested from Roman Ashkelon only nineteen specimens provided results (Faerman *et al.* 1998: 861). These three studies indicate that DNA sex assessment techniques proved to be not only expensive but also relatively unsuccessful on archaeological infant skeletal remains (Waldron *et al.* 1999: 71). Therefore, the sex assessment methods using observation and measurement of skeletal morphology of infants are still necessary (Waldron *et al.* 1999: 71).

Summary of the Sex Assessment Methods

The review of sex assessment method of subadults has indicated that whilst DNA techniques may be more definitive, the poor DNA survival rate and high expense precludes its use within this study. Instead the sex assessment of the Anglo-Saxon and medieval subadults will use the rapid observation techniques of the morphological criteria of the ilium and mandible of Schutkowski (1993), supported by a metrical analysis using the discriminant functions for the ilium and femur from Schutkowski

(1990; 1987). As with the recording of diaphyseal lengths, measurements of the ilia were taken from both the left and right sides, using sliding calipers, and then averaged to reduce the effect of bias discussed previously. To avoid any possible confusion morphological traits of the mandible and ilium were recorded using the alphabetical definitions shown in Table 9.10 rather than a point scoring system. So that they can be utilised by future researchers the raw measurements and morphological observations for each individual are provided in Files 2 and 3 on the CD.

Table 9.10: Definitions of sexing categories used.

U	Undetermined sex	Insufficient data available for sex assessment
F	Female	The features are highly feminine
F?	Possible female	The features are more feminine that masculine
I	Indeterminate	The features are ambiguous
M?	Possible Male	The features are more masculine than feminine
M	Male	The features are highly masculine

Infant Mortality Rate Ratio

The analysis of the sex of the children could provide evidence towards the argument of the practice of infanticide in Anglo-Saxon and medieval England if abnormalities are found within the mortality profile. It is, however, necessary to first discover what constitutes a normal mortality pattern before we are able to interpret any abnormalities. In the review in Chapter 3 it was discovered that within human populations there is a naturally higher ratio of male conceptions to female, along with the greater mortality susceptibility of males. This would suggest that in a normal mortality situation we would expect more male than female neonatal infants to be recovered from the archaeological record. On the other hand, if there are a disproportionately large number of female children within the archaeological populations it may be possible that an abnormal mortality profile has occurred.

Possibly through a culturally determined sex preference of males that provides greater nourishment and maternal care, or even the preferential infanticide of females.

To analyse and interpret the sex profiles of the Anglo-Saxon and medieval individuals, it is necessary to standardise the data in order to overcome the issues associated with the comparison of differently sized populations. This will be done by using an adaption of the Infant Mortality Rate Ratio (IMRR) which is described by Fuse and Crenshaw (2006: 363) as: (IMRmale / IMRfemale) * 100. Thus, the IMRR expresses, in a standardised format, the number of male infant deaths for every 100 female infant deaths (Fuse & Crenshaw 2006: 363). Whilst Fuse and Crenshaw (2006: 363) only studied the infant population this study includes older children and so it was deemed appropriate to just use the term Mortality Rate Ratio (MRR) although the calculation principal will remain the same. Interpreting the MRR requires caution. While an MRR of 100 might seem the ‘‘norm,’’ the expected value should in fact be considerably higher than 100 because of the greater biological vulnerability of males; see Chapter 3 for further discussion (Fuse & Crenshaw 2006: 364). To compensate for the natural variability of mortality rates between the sexes, the MRR for different age categories of the archaeological populations will be compared to the MRR calculated from modern United Nations demographic data.

Reliability Testing

Reliability is a technical standard to be considered when selecting any procedure to be used in collecting research data (Johnston & Mack 1985: 285; Sim & Wright 2005: 258). It refers to the extent to which a particular procedure will yield the same results when applied again under the same conditions (Johnston & Mack 1985: 285; Sim &

Wright 2005: 258). Reliability is of particular concern for anthropometric data, since many factors (endogenous as well as exogenous) contribute to the error of measurement and hence the reliability (Johnston & Mack 1985: 285). Due to the controversy among biological anthropologists concerning the success of sex assessment of subadults from skeletal remains it was decided to perform reliability tests on the sex estimation methods to ensure the techniques are replicable. Tests for intra-observer and inter-observer error were conducted for the observations of the mandible and ilium used in morphological sex assessment, and the measurements of femur and ilium used in metrical sex assessment. The individuals from St. James and St. Mary Magdalene Chichester were chosen for this study as this is a large collection (62) of generally well preserved individuals representing all the age groups relevant to this study.

The intra-observer test compares the initial observations recorded for the Chichester assemblage by the author conducted between March-May 2009 (AD1) with observations recorded eight months later in February 2010 (AD2). The inter-observer test compares the observations for the Chichester assemblage recorded by the author (AD1 and AD2) with those recorded by a fellow research student Laura Calderwood (LBC). The author provided diagrams and descriptions of the metrical techniques and morphological observation methods as described above. All measurements were recorded to the nearest tenth of a millimetre, and to avoid any possible confusion the morphological traits of the mandible and ilium were recorded using the alphabetical codes shown above in Table 9.10, rather than a point scoring system.

Reliability Testing of Morphological Sex Assessment Results

The Fleiss (1971) Kappa test of agreement was used to compare the scores obtained from the morphological traits between observers. This test determines how well subjects rated on a nominal scale by different raters agree with each other. It can be interpreted as expressing the extent to which the observed amount of agreement among observers exceeds what would be expected if all observers made their ratings completely randomly.

Kappa (*k*) can be defined as: $k = \frac{P - P_e}{1 - P_e}$

The Kappa statistic calculates the degree of agreement in classification over that which would be expected by chance and is scored as a number between 0 and 1. If the observers are in complete agreement then k = 1, when agreement between the variables is due to chance k = 0, if there is no agreement among the observers (other than what would be expected by chance) then k < 0 (Fleiss 1973: 146). There is no generally agreed on measure of significance, although guidelines have been given such as that by Landis and Loch (1977: 165), shown in Table 9.11, which are described by the authors as useful 'benchmarks', although entirely arbitrary.

Table 9.11: Interpretation of Kappa (afterLandis & Koch 1977: 165).

Kappa Statistic	Strength of Agreement
<0	Poor
0.01-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1	Almost Perfect

Two Kappa tests of agreement were performed; firstly to compare the intra-observer error (AD1 & AD2) which is shown in Table 9.12, secondly to compare the inter-observer error (AD1, AD2 & LBC) which is shown in Table 9.13. The results from this investigation indicated that the agreement between observers exceeded what would be expected by chance for all the morphological methods tested. However, for this research it was decided to dismiss any methods that produced a Kappa rating below 0.50 as an effort to further improve the accuracy of recordings. Subsequently two of the methods tested for intra and inter reliability – 'curvature of the iliac crest' and 'shape of the anterior dental arcade' – were rejected from further examination within this research. Thus only the five remaining morphological sex estimation methods were employed in the analysis of the Anglo-Saxon and medieval individuals.

Table 9.12: Results from the Kappa test for intra observer error (AD1 & AD2).

Criteria	N	Kappa
Angle of the greater sciatic notch	124	0.644
Arch criterion	124	0.571
Curvature of the iliac crest	124	0.421
Depth of the greater sciatic notch	124	0.639
Eversion of the gonion region	62	0.574
Protrusion of the chin region	62	0.599
Shape of the anterior dental arcade	62	0.543

Table 9.13: Results from the Kappa test for inter-observer error (AD1, AD2 & LBC).

Criteria	N	Kappa
Angle of the greater sciatic notch	124	0.612
Arch criterion	124	0.614
Curvature of the iliac crest	124	0.429
Depth of the greater sciatic notch	124	0.538
Eversion of the gonion region	62	0.517
Protrusion of the chin region	62	0.566
Shape of the anterior dental arcade	62	0.428

Reliability Testing of Metric Sex Assessment Methods

Imprecision is the variability of repeated measurements, and is due to intra- and inter-observer measurement differences (Ulijaszek & Kerr 1999: 166). The most commonly used measure of imprecision is Dahlberg's (1947) Technical Error of Measurement (TEM), which is the square root of measurement error variance (Adão Perini *et al.* 2005: 86; Knapp 1992: 236; Ulijaszek & Kerr 1999: 166). Defined as:

$$\mathrm{TEM} = \sqrt{\frac{(\Sigma \mathrm{D}^2)}{2\mathrm{N}}}$$

(Where *D* is the difference between the replicated measurements and *N* is the number of the

Acceptable levels of measurement error are difficult to ascertain because TEM is age dependent, and the value is also related to the anthropometric characteristics of the group or population under investigation (Ulijaszek & Kerr 1999: 165). The size of the TEM may be positively associated with the size of measurement, where large mean values are associated with high TEM and small mean values with low TEM (Ulijaszek & Kerr 1999: 167). The positive association between TEM and size of measurement is problematic, since comparative imprecision of different measurements cannot be assessed (Ulijaszek & Kerr 1999: 167). In order to compare TEM collected on different variables or different populations, it is necessary to use the coefficient of reliability (R), which ranges from 0 to 1, and can be calculated using the equation:

$$R = 1 - \left(\frac{(\mathrm{TEM})^2}{SD^2}\right)$$

where SD^2 is the total inter-subject variance for the study in question, including measurement error (Ulijaszek & Kerr 1999: 168). This coefficient is the most widely used measure of anthropometric precision in population studies and reveals the proportion of between-subject variance in a measured population which is free from measurement error (Ulijaszek & Kerr 1999: 168). In the case of a measurement with an R of 0.95, 95% of the variance is due to factors other than measurement error (Ulijaszek & Kerr 1999: 168). The data from the measurements were then tested for repeatability using TEM analysis. The repeated measurements are each subtracted from the initial measurement then evaluated to obtain P values defined as:

$$P = TEM^2/standard\ deviation^2$$

If P < 0.05 it can be stated that the measurements have low error rates and as such are replicable.

The Technical Error of Measurement was performed twice; firstly to compare the intra-observer error (AD1 & AD2) as is shown in Table 9.14, secondly to compare the inter-observer error (AD1, AD2 & LBC) which is shown in Table 9.15. The results from the investigation of intra-observer error indicated that that all measurements have low error rates and are thus replicable with minimum error. However, the results for the inter-observer error indicate that two measurements 'width of the greater sciatic notch' and 'depth of the sciatic notch' have slightly higher error rates and as such are not replicable. It is perhaps not surprising that these two more intricate measurements have the least agreement of all the measurements tested. Any replicated measurement is also undoubtedly affected by the fragile nature of the archaeological bones measured. It is also possible that greater experience in working with the delicate material increases proficiency in replicating measurements. As such it was considered that a reliability coefficient greater than 90% was acceptable for this study, but greater caution and lesser preference was given to those sex estimation methods that employ the 'width of the greater sciatic notch' and 'depth of the sciatic notch'.

Table 9.14: Result of Intra-observer TEM (AD1 & AD2), with Reliability Coefficient (R) and *P* values.

Measurement	Number of Individuals	TEM	*P*	R%
Width of greater sciatic notch	34	0.906	*0.031	96.862
Depth of the greater sciatic notch	35	0.251	*0.017	98.212
Ilium Breadth	17	0.370	***0.000	99.932
Ilium Length	12	0.239	***0.000	99.982
Femur Length	28	0.257	***0.000	99.997

Table 9.15: Result of Inter-observer TEM (AD1, AD2 and LBC), with Reliability Coefficient (R) and *P* values.

Measurement	Number of Individuals	TEM	P	R%
Width of greater sciatic notch	27	1.453	0.082	91.744
Depth of the greater sciatic notch	29	0.484	0.066	93.365
Ilium Breadth	10	0.586	**0.003	99.666
Ilium Length	7	0.339	**0.001	99.887
Femur Length	17	0.420	***0.000	99.992

Summary of Methods

This chapter examined the various techniques available for the osteoarchaeologist to estimate the age-at-death and determine the sex of subadults. The final methods chosen to examine the 1275 Anglo-Saxon and medieval subadults are now summarised, with the results of the analysis presented in Chapter 10. This review indicated the importance of selecting age-at-death estimation methods appropriate for the age of the individual. It was decided to estimate the age-at-death of the perinatal individuals using the ICH data regression technique for diaphyseal length from Scheuer and colleagues (1980) because this is the regression method that includes the largest number of functions for different skeletal elements which makes it the method most suited to friable archaeological material. In the age-at-death estimation of older subadults, dental development shows greater accuracy and so the progress of dental mineralisation and formation was recorded using the descriptions provided by Moorrees and colleagues (1963b: 206) and Ubelaker (1999: 64). Diaphyseal length, using Ubelaker (1999: 70-71 table 14), was used to estimate the age-at-death for older children when dentition was not present. If neither dentition nor long bones were present, the development of primary ossification centres was recorded for that individual.

Despite the long held controversy within the biological anthropological literature regarding the sex assessment of subadults from skeletal remains, this chapter has shown that there are reported methods with diagnostic accuracy comparable to that known for adult individuals. The sex assessment of the Anglo-Saxon and medieval children was undertaken using a weighted combination of the five morphological criteria of the ilium and mandible from Schutkowski (1993) that were considered to be replicable, after reliability testing using Fleiss (1971) Kappa test of agreement; the angle of the greater sciatic notch, the arch criterion, the depth of the greater sciatic notch, the eversion of the gonion region and the protrusion of the chin region. The morphological observations were supported by the metrical analysis using the discriminant functions for the ilium and femur from Schutkowski's (1990; 1987). However, greater caution and lesser weighting was given to these discriminant functions as all required either the 'width of the greater sciatic notch' or the 'depth of the sciatic notch' both of which were shown to be less replicable in tests using Dahlberg's (1947) Technical Error of Measurement.

The sex data for each age category of the differently sized Anglo-Saxon and medieval samples was then standardised using the Mortality Rate Ratio (which expresses the number of male deaths for every 100 female deaths). The Mortality Rate Ratios of the archaeological populations were then compared with United Nations demographic data to examine the possibility of an abnormal mortality profile that may suggest that infanticide was practiced.

Chapter 10

Results

Introduction

The following chapter presents the results of the osteoarchaeological analysis of the Anglo-Saxon and medieval subadults. The age-at-death estimation and sex assessment methods described in Chapter 9 were used to determine the age and sex each individual. The mortality profiles from the different populations were then examined and are discussed below. This is followed by the results of the palaeopathological analysis which explores the occurrence of stress and disease from the Anglo-Saxon and medieval subadult populations from the observation of the lesions described in Chapter 8.

Results of the Analysis of the Anglo-Saxon and Medieval Perinatal Infants

In an attempt to provide results comparable with previous archaeological investigations on infanticide the initial focus of this research examines only the perinatal individuals which were aged from diaphyseal lengths using the ICH data regression technique from Scheuer and colleagues (1980). A total of 330 perinatal individuals were identified from their diaphyseal length measurements. For this analysis the perinatal individuals are examined by period – early Anglo-Saxon, late Anglo-Saxon and medieval; the age-at-death distribution of perinatal individuals from each site can be found in Appendix 3.

The Age and Sex Distribution of Perinatal Infants

The age-at-death distribution of the 330 perinatal infants is shown in Figure 10.1, where we see that both the early and late Anglo-Saxon periods (Figures 10.1a & 10.1b) show a strong peak around full term (38-40 weeks). Whilst a peak at full term is still present for the medieval sample (Figure 10.1c) it is much less pronounced with a flatter profile visible due to increased proportions of infants in 29-31 and 44-46 week categories. In order to provide a statistical analysis of the age distributions shown in the charts, the two-sample two-tailed Kolmogorov-Smirnov test (Siegel 1956: 131) was performed on the percentage of individuals for each age category. The Kolmogorov-Smirnov two-sample two-tailed statistic (Siegel 1956: 131) was chosen because it is sensitive to any kind of difference in the distributions including differences in location (central tendency), in dispersion and in skewness. The results of the Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) shown in Table 10.1 indicate that whilst the greatest variation is seen between the early Anglo-Saxon and medieval perinatal age distributions these are not significantly different.

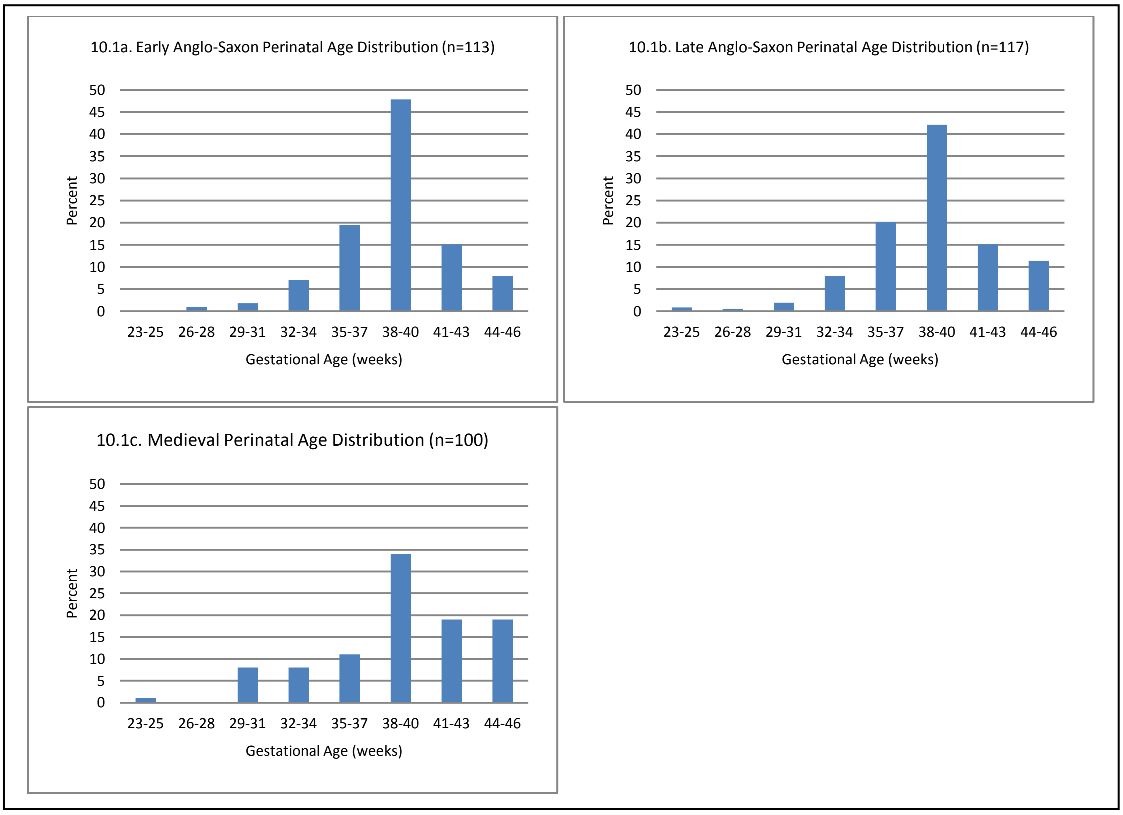


Figure 10.1: Age-at-death distribution of perinatal infants.

Table 10.1: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) on the perinatal age distributions indicate that the perinatal distributions do not differ at the 5% level – D_{obs} is less than D_{95}.

Periods Compared	D_{obs}	D_{95}
Early Anglo-Saxon & Late Anglo-Saxon	0.10	0.19
Early Anglo-Saxon & Medieval	0.15	0.19
Late Anglo-Saxon & Medieval	0.09	0.19

The pattern of central tendency around full term observed for both the early and late Anglo-Saxon periods (Figures 10.1a & 10.1b) shows some visible similarities to those observed by Mays (1993) in Romano-British populations (Figures 10.2a & 10.2b). It was the similarities between the Romano-British populations (Figures 10.2a & 10.2b) to the distribution of total modern live births (Figure 10.2f), and their differences to the distributions of the modern still births (Figure 10.2d) and modern natural deaths within seven days of birth (Figure 10.2e), that led Mays (1993: 887) to the conclusion that infanticide was practiced in sufficient numbers to have had a dominant effect on the Romano-British perinatal age-at-death distributions. However, the statistical comparison (in Table 10.2) of the Anglo-Saxon and medieval perinatal age-at-death distributions (Figure 10.1) to the Roman-British and modern populations from Mays' (1993) study (Figure 10.2), indicates that visible comparisons alone can be misleading. For example, Table 10.2 shows that, despite the peak at full term, the distribution of perinatal individuals from the late Anglo-Saxon period (Figure 10.1b) is actually statistically different from that of both Romano-British samples (Figures 10.2a & 10.2b) and of the total modern live births (Figure 10.2f). Conversely, although the medieval sample (Figure 10.1c) appears to have a flatter distribution, it is not significantly different from the Romano-British cemeteries (Figure 10.2a) or the total modern live births (Figure 10.2f). Table 10.2 indicates that the distribution of all three studied periods; early Anglo-Saxon (Figure 10.1a), late Anglo-Saxon (Figure 10.1b) and medieval (Figure 10.1c), are statistically different from the distributions for modern still births (Figure 10.2d) and modern live births dying within 7 days of birth (Figure 10.2e). This would suggest that the mortality profiles of these archaeological samples are somewhat abnormal as they differ from the expected age-at-death distribution for perinatal individuals. The distributions for the early Anglo-Saxon and medieval periods (Figures 10.1a & 10.1c) show greater abnormalities as neither are significantly different to the total modern live births (Figure 10.2f); therefore both show more similarity to the birth population than the expected mortality distribution for perinatal individuals.

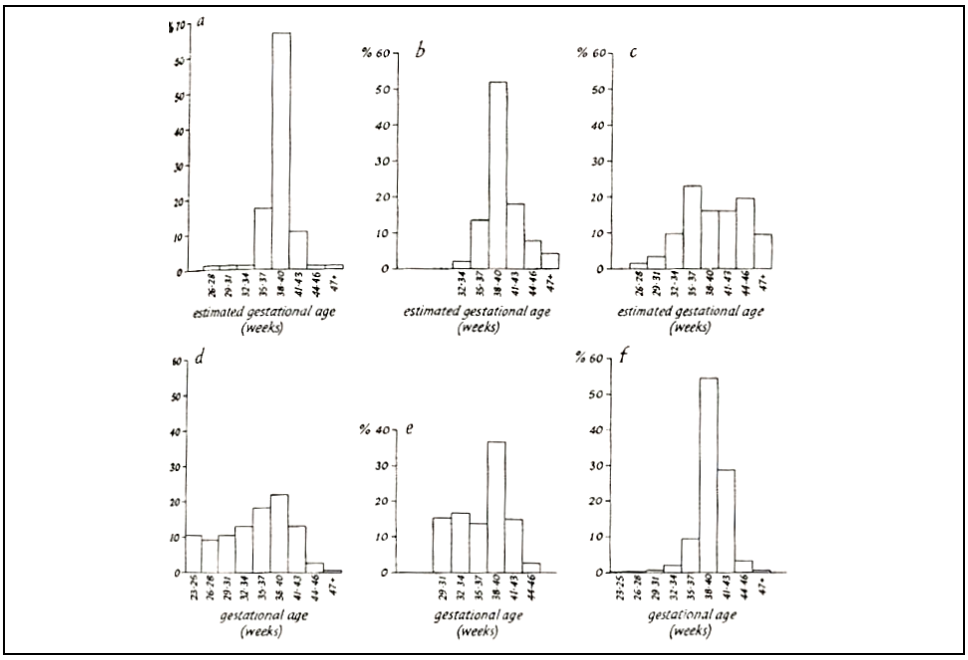


Figure 10.2: Distributions of ages of archaeological and modern perinatal infants.
a. Romano-British villas and settlements.
b. Romano-British cemeteries.
c. Wharram Percy.
d. Modern still births.
e. Modern live births dying within 7 days of birth.
f. Total modern live births. (after Mays 1993: 885)

Table 10.2: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the Anglo-Saxon and medieval perinatal age distributions shown in Figure 10.1 with the archaeological and modern distributions Mays (1993) shown in Figure 10.2. Site distributions that are significantly different at the 5% level (D_{obs} equal to or greater than D_{95}) are indicated with an asterisk.

Sites compared	Early Anglo-Saxon (Figure 10.1a)		Late Anglo-Saxon (Figure 10.1b)		Medieval (Figure 10.1c)	
	D_{obs}	D_{95}	D_{obs}	D_{95}	D_{obs}	D_{95}
Figure 10.2a. Romano-British Villas	0.11	0.19	*0.20	0.19	*0.26	0.19
Figure 10.2b. Romano-British Cemeteries	0.12	0.19	*0.20	0.19	0.15	0.19
Figure 10.2c. Wharram Percy	0.17	0.19	0.08	0.19	0.14	0.19
Figure 10.2d. Modern still births	*0.34	0.19	*0.30	0.19	*0.34	0.19
Figure 10.2e. Modern live births dying within 7 days of birth	*0.23	0.19	*0.19	0.19	*0.21	0.19
Figure 10.2f. Total modern live births	0.17	0.19	*0.25	0.19	0.16	0.19

The results of the sex assessment of the Anglo-Saxon and medieval perinatal infants are shown in Table 10.3 (the results for each site can be found in Appendix 3). A total of 330 perinatal infants were examined from the three periods, however, 117 individuals had no remaining ilium or mandible and so sex assessment could not be performed. Of the 214 individuals that retained sexually diagnostic elements fourteen individuals were of indeterminate sex, eighty-four male, and 116 female. A chi-square test was performed for each age category, as well as the total number of males and females for each period, to determine if there was a statistically significant difference in the mortality of males and females (see Table 10.3).

Table 10.3: Age and sex distribution of perinatal infants. The χ^2 test and the Perinatal Mortality Rate Ratio were performed on the Female and Male frequencies. As it is only possible to successfully run the chi-square test if the expected value is at least five, the statistic was not used on age categories with less than ten sexed individuals (males and females combined).

Early Anglo-Saxon

Gestational Age (weeks)	Number of perinates examined	Perinates with no ilium or mandible	Number of Sexed Perinates	Indeterminate	Female	Male	χ^2	P=	Perinatal Mortality Rate Ratio
23-25	0	0	0	0	0	0	-	-	-
26-28	1	1	0	0	0	0	-	-	-
29-31	2	1	1	0	1	0	-	-	0
32-34	8	5	3	0	2	1	-	-	50
35-37	22	15	7	1	1	5	-	-	500
38-40	54	33	21	3	11	7	0.89	0.346	64
41-43	17	6	11	1	7	3	1.60	0.206	43
44-46	9	5	4	0	3	1	-	-	33
Total	113	66	47	5	25	17	1.52	0.217	68

Late Anglo-Saxon

Gestational Age (weeks)	Number of perinates examined	Perinates with no ilium or mandible	Number of Sexed Perinates	Indeterminate	Female	Male	χ^2	P=	Perinatal Mortality Rate Ratio
23-25	3	1	2	0	2	0	-	-	0
26-28	0	0	0	0	0	0	-	-	-
29-31	2	1	1	1	0	0	-	-	-
32-34	11	3	8	1	4	3	-	-	75
35-37	27	10	17	1	11	5	2.25	0.134	45
38-40	37	10	27	0	15	12	0.33	0.564	80
41-43	16	4	12	0	4	8	1.33	0.248	200
44-46	21	5	16	2	6	8	0.29	0.593	133
Total	117	34	83	5	42	36	0.46	0.497	86

Medieval

Gestational Age (weeks)	Number of perinates examined	Perinates with no ilium or mandible	Number of Sexed Perinates	Indeterminate	Female	Male	χ^2	P=	Perinatal Mortality Rate Ratio
23-25	1	0	1	0	1	0	-	-	0
26-28	0	0	0	0	0	0	-	-	-
29-31	8	2	6	0	4	2	-	-	50
32-34	8	0	8	0	5	3	-	-	60
35-37	11	0	11	1	9	1	6.40	*0.011	11
38-40	34	7	27	2	14	11	0.36	0.549	79
41-43	19	4	15	1	8	6	0.29	0.593	75
44-46	19	3	16	0	8	8	0	1	100
Total	100	16	84	4	49	31	4.05	*0.044	63

The age distribution of the sexed perinatal individuals shown in Figure 10.3 for the early Anglo-Saxon (Figure 10.3a) and medieval (Figure 10.3c) periods have visibly similar to the profiles created by all perinatal infants for the same periods seen in Figures 10.1a & 10.1c. The exclusion of unsexed perinatal individuals from the late Anglo-Saxon period in Figure 10.3b, however, creates a visibly different age-at-death profile to that of total number of late Anglo-Saxon perinates shown in Figure 10.1b, with less of a peak at full term. From Table 10.4 we see that the distribution of sexed perinatal individuals from the late Anglo-Saxon period (Figure 10.3b), like the total number of late Anglo-Saxon perinates (Figure 10.1b), is statistically different from distributions of the Romano-British villas (Figure 10.2a) and total modern live births (Figure 10.2f). However, unlike the total number of late Anglo-Saxon perinates (Figure 10.1b), there is not a significant difference between the sexed perinatal individuals from the late Anglo-Saxon period (Figure 10.3b) and the Romano-British cemeteries (Figure 10.2b). Nevertheless, the Kolmogorov-Smirnov two-sample test shown in Table 10.5 indicates that these two late Anglo-Saxon distributions (shown in Figures 10.1b & 10.3b) are not actually statistically different ($\mathrm{D_{obs}} = 0.03$, $\mathrm{D_{95}}$ = 0.19).

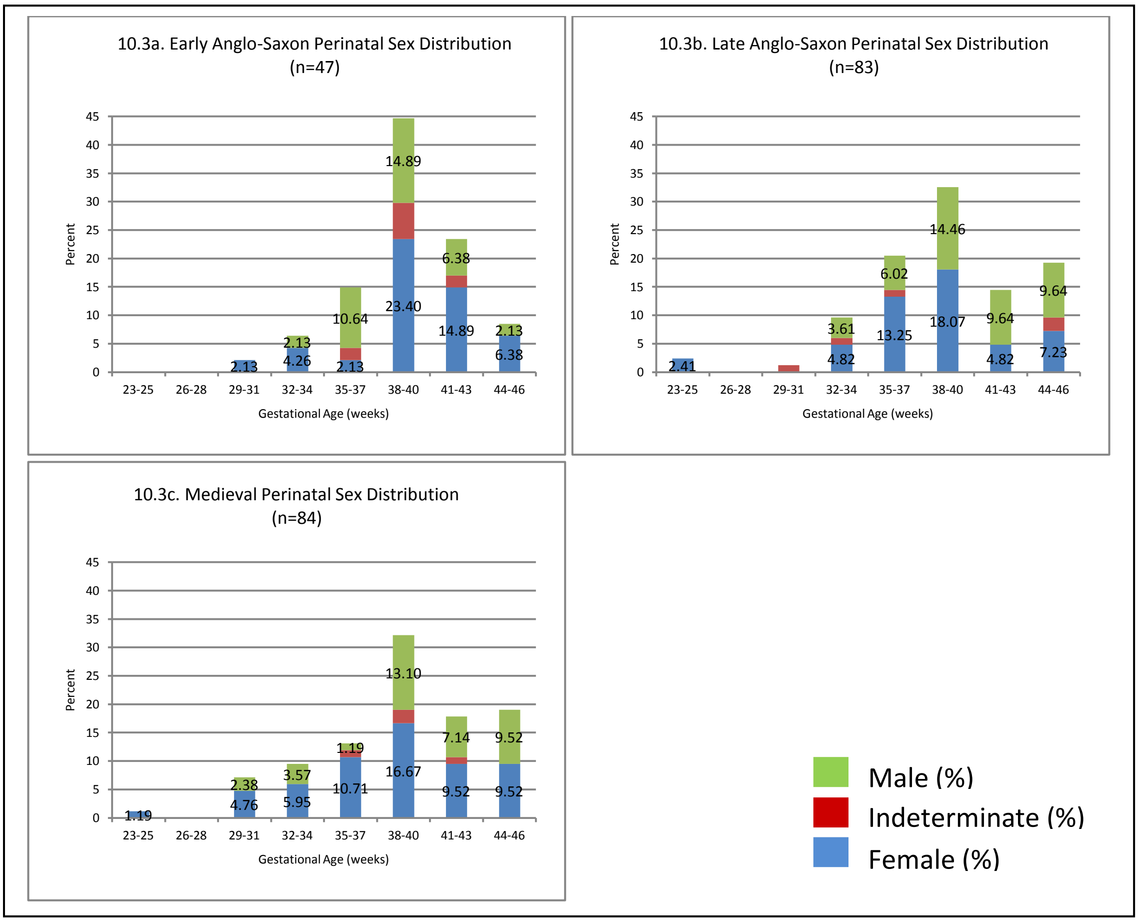


Figure 10.3: Age distribution of sexed perinatal infants by period.

Table 10.4: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distributions the sexed perinatal infants from the Anglo-Saxon and medieval periods shown in Figure 10.3 with the archaeological and modern distributions Mays (1993) shown in Figure 10.2. Sites with distributions that are significantly different at the 5% level (D_{obs} is equal to or greater than D_{95}) are indicated with an asterisk.

Sites compared	Early Anglo-Saxon (Figure 10.3a)		Late Anglo-Saxon (Figure 10.3b)		Medieval (Figure 10.3c)	
	D_{obs}	D_{95}	D_{obs}	D_{95}	D_{obs}	D_{95}
Figure 10.2a. Romano-British Villas	*0.20	0.19	*0.22	0.19	*0.25	0.19
Figure 10.2b. Romano-British Cemeteries	0.07	0.19	0.17	0.19	0.15	0.19
Figure 10.2c. Wharram Percy	0.18	0.19	0.08	0.19	0.11	0.19
Figure 10.2d. Modern still births	*0.39	0.19	*0.31	0.19	*0.31	0.19
Figure 10.2e. Modern live births dying within 7 days of birth	*0.24	0.19	*0.20	0.19	*0.20	0.19
Figure 10.2f. Total modern live births	0.11	0.19	*0.22	0.19	*0.19	0.19

Table 10.5: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the age distributions of all perinatal infants shown in Figure 10.1 to the age distribution of sexed perinatal infants from each period (Figure 10.3) indicate that the distributions do not differ at the 5% level – D_{obs} is less than D_{95}.

Period	D_{obs}	D_{95}
Early Anglo-Saxon	0.09	0.19
Late Anglo-Saxon	0.03	0.19
Medieval	0.03	0.19

Table 10.4 indicates that the age-at-death distribution for the sexed Anglo-Saxon and medieval perinatal individuals (Figures 10.3a, 10.3b and 10.3c) are statistically different to the expected mortality distribution for perinatal individuals; both the modern still births (Figure 10.2d) and modern live births dying within 7 days of birth (Figure 10.2e). This would suggest that the age-at-death distribution for the sexed Anglo-Saxon and medieval perinatal individuals (Figures 10.3a, 10.3b and 10.3c) are not normative mortality patterns. This is more obvious for the age distribution of sexed perinatal individuals from the early Anglo-Saxon period (Figure 10.3a) which appears to have a more pronounced central tendency than the other two periods (Figures 10.3b & 10.3c). We also see from Table 10.4 that the early Anglo-Saxon period (Figure 10.3a) is the only one of the three studied periods not to be statistically different from the distribution for total modern live births (Figure 10.2f). This would suggest that the distribution of sexed perinatal individuals from the early Anglo-Saxon period (Figure 10.3a) represents an abnormal mortality pattern with a greater than expected proportion dying at full term. Furthermore, whilst the Kolmogorov-Smirnov two-sample tests shown in Table 10.6 do not indicate any statistically significant differences, it is interesting to note that the late Anglo-Saxon distribution (Figure 10.3b) has more similarity statistically to the medieval distribution (Figure 10.3c) than that of the early Anglo-Saxon period (Figure 10.3a).

Table 10.6: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) on the distribution of sexed perinatal individuals shown in Figure 10.3 indicate that the perinatal distributions do not differ at the 5% level – D_{obs} is less than D_{95}.

Periods Compared	D_{obs}	D_{95}
Early Anglo-Saxon - Late Anglo-Saxon	0.11	0.19
Early Anglo-Saxon - Medieval	0.11	0.19
Late Anglo-Saxon - Medieval	0.05	0.19

As can be seen from the sex distribution shown in Table 10.3 and Figure 10.3, all three periods show a higher proportion of females to males. The results of chi-square tests on the frequencies of male and female perinatal infants indicate that only in the case of the medieval sample was there a statistically significant difference between the proportions of male to female perinates. Nevertheless, the chi-square result does not provide any indication as to whether the sex distributions of the Anglo-Saxon and medieval perinatal infants reflect a normal mortality profile, as the statistic does not take into account the natural biological disadvantage of males.

The Perinatal Mortality Rate Ratio

The Mortality Rate Ratios (MRR) of infant deaths within twenty-seven days of birth from twenty-two modern countries were calculated from the United Nations (2007) demographic data and are displayed in Figure 10.4 (the individual male and female Mortality Rates for each country listed in Appendix 4). The average (mean) MRR of these twenty-two countries is 125.54, with a standard deviation of 10.93. This indicates that on average there are 125.54 male to every 100 female infant deaths within the first month after birth. Therefore, an ‘expected’ MRR should range from 114.62-136.47, and an MRR below this range can be an indication of excess female infant mortality.

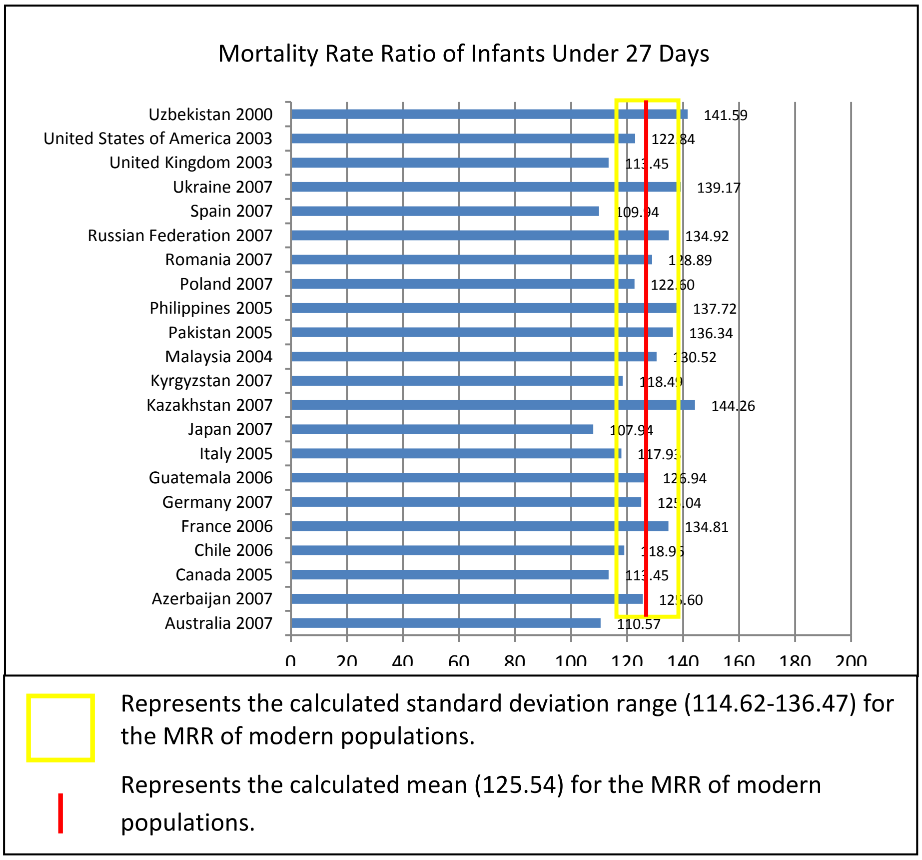


Figure 10.4: Modern national Mortality Rate Ratios for infant deaths under 27 days

The calculated MRR for the Anglo-Saxon and medieval perinatal infants are shown in Figure 10.5. There is only one example from all three periods of an MRR within the expected range; the late Anglo-Saxon 44-46 age group in Figure 10.5b. Excess male mortality is indicated by the high MRR for the early Anglo-Saxon 35-37 age category in Figure 10.5a and the late Anglo-Saxon 41-43 age category in Figure 10.5b. For the majority of age groups from all three periods the MRR is instead below the expected range of 144.62-136.47, indicating excess female mortality.

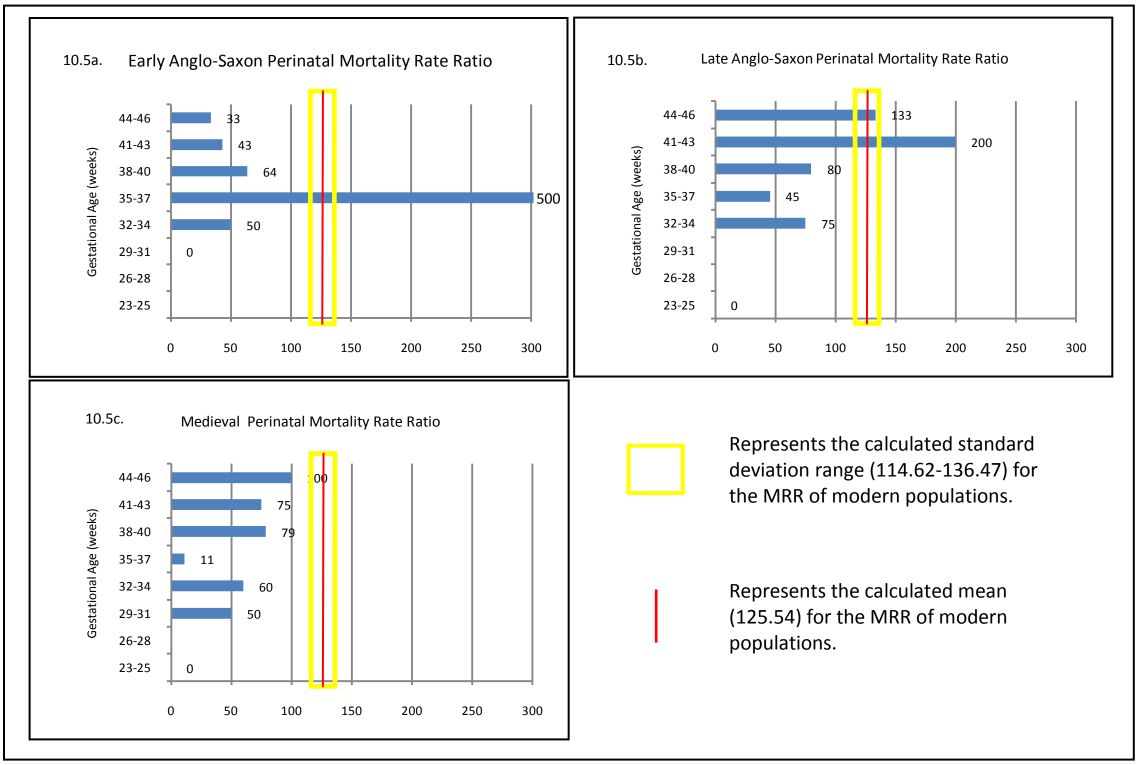


Figure 10.5: Perinatal Morality Rate Ratio by period.

The Age and Sex Distribution of Perinatal Individuals from Selected Sites

The representation of perinatal infants from the archaeological assemblages is, however, generally low with larger concentrations of perinates excavated from only a small number of the analysed sites as is shown in Table 10.7. Further investigation was conducted on those six sites with ten or more sexed perinatal infants recovered (Great Chesterford, Cherry Hinton, Raunds, Hereford Cathedral, medieval St Oswalds, Gloucester and Stonar), starting with the examination of the age and sex distribution shown in Figure 10.6. The only early Anglo-Saxon site with a large proportion of sexed infants is Great Chesterford (Figure 10.6a) which, like the distribution in Figure 10.3a of the early Anglo-Saxon period as a whole, shows a strong peak at full term, the similarity of these distributions are indicated by the non-significant result of the Kolmogorov-Smirnov two-sample test shown in Table 10.8. Great Chesterford (Figure 10.6a), also has a similar age distribution to the total modern live births in Figure 10.2f, also indicated by the non-significant result of the Kolmogorov-Smirnov two-sample test shown in Table 10.9 indicating an abnormal burial assemblage.

Table 10.7: Number of sexed perinatal infants from each site.

Early Anglo-Saxon Sites

Site Name	Total	Undetermined sex	Indeterminate sex	Number of Females	Number of Males	Males and Females
Alton, Mount Pleasant	0	0	0	0	0	0
Barrington Edix Hill	1	0	0	1	0	1
Beacon Hill	2	0	1	0	1	1
Bradstow School, Broadstairs	0	0	0	0	0	0
Burwell	0	0	0	0	0	0
Cannington	16	11	0	3	2	5
Dover Buckland	1	0	0	0	1	1
Droxford	0	0	0	0	0	0
Eccles	3	1	0	0	2	2
Finglesham	0	0	0	0	0	0
Great Chesterford	69	44	3	13	9	22
Henley Wood	5	1	0	4	0	4
Holborough	0	0	0	0	0	0
Lechlade Butler's Field	4	1	1	2	0	2
New Wintles	0	0	0	0	0	0
Portway East	0	0	0	0	0	0
Queenford Farm	1	0	0	0	1	1
Redcastle Furze	3	3	0	0	0	0
Stanton Harcourt	0	0	0	0	0	0
Station Road, Gamlingay	7	5	0	1	1	2
Watchfield	0	0	0	0	0	0
Winnall	0	0	0	0	0	0
Worthy Park	1	0	0	1	0	1

Late Anglo-Saxon Sites

Site Name	Total	Undetermined sex	Indeterminate sex	Number of Females	Number of Males	Males and Females
Cherry Hinton	64	28	4	12	20	32
Cirencester Abbey	0	0	0	0	0	0
Norwich North-East Bailey	7	0	1	4	2	6
Nunnaminster	0	0	0	0	0	0
Raunds	36	3	0	21	12	33
Romsey Abbey	2	2	0	0	0	0
St. Oswalds, Gloucester	4	1	0	2	1	3
Staple Gardens	4	0	0	3	1	4

Medieval Sites

Site Name	Total	Undetermined sex	Indeterminate sex	Number of Females	Number of Males	Males and Females
Chichester	7	1	0	3	3	6
Cirencester Abbey	1	0	0	0	1	1
Clopton	1	0	0	0	1	1
Comet Place	4	2	0	1	1	2
Cuddington	3	0	1	0	2	2
East Smithfield	7	0	1	5	1	6
Eynsham Abbey	0	0	0	0	0	0
Gloucester Blackfriars	2	0	0	1	1	2
Guildhall Yard	2	0	0	2	0	2
Hereford Cathedral	14	2	0	8	4	12
Huntington Orchard Lane	0	0	0	0	0	0
Leominster	1	0	0	1	0	1
Market Street, Winchester	0	0	0	0	0	0
New Romney	0	0	0	0	0	0
Spital Square	1	0	0	1	0	1
St Benet Sherehog	2	0	0	0	2	2
St Gregory's Priory Canterbury	1	1	0	0	0	0
St Nicholas Shambles	2	0	0	2	0	2
St. John Clerkenwell	1	0	0	1	0	1
St. Mary Graces	2	0	0	2	0	2
St. Oswalds, Gloucester	29	7	0	13	9	22
Stonar	20	3	2	9	6	15

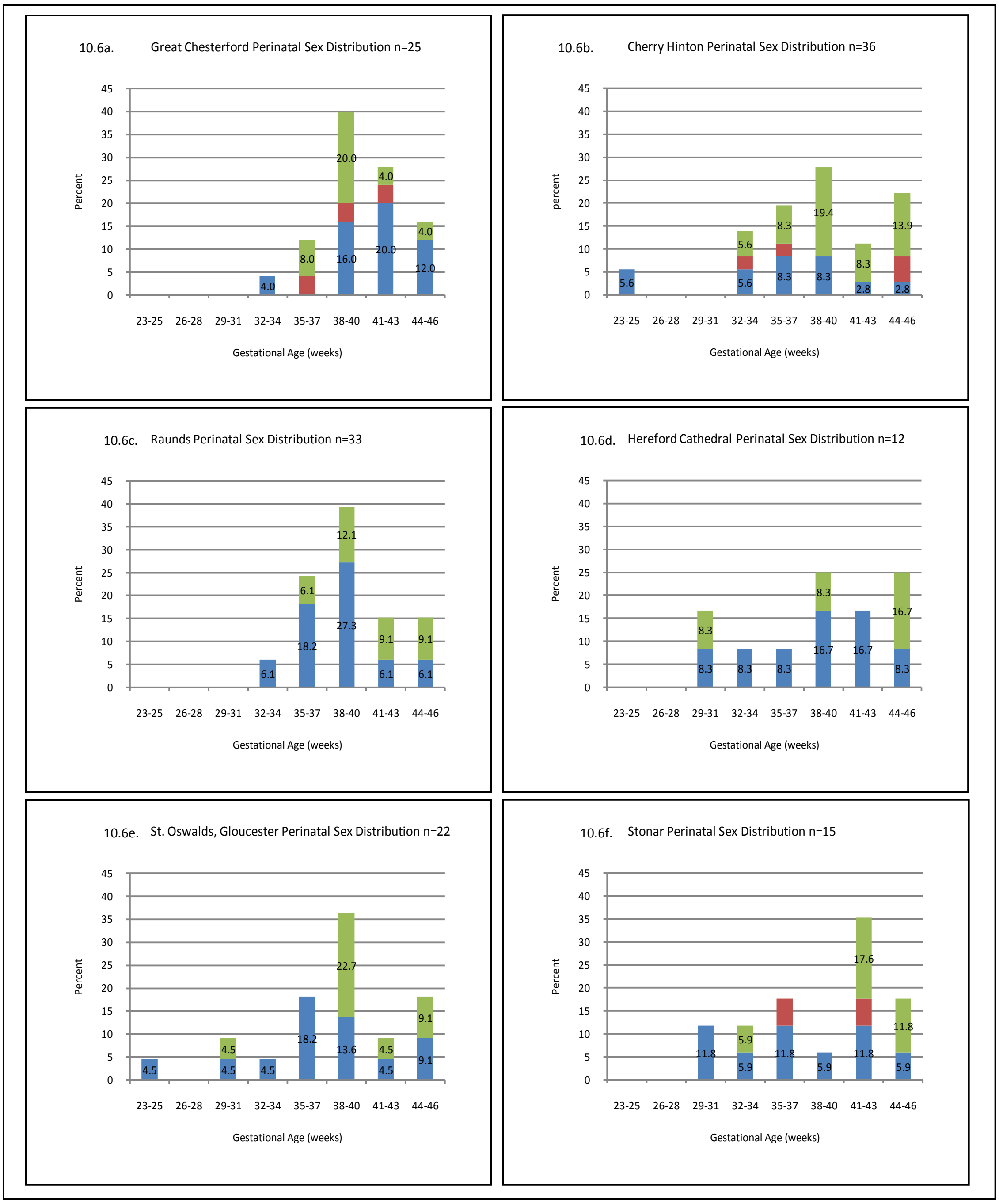


Figure 10.6: Age distribution of sexed perinatal infants by site.

Male (%) Indeterminate (%) Female (%)

Table 10.8: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distribution of sexed perinatal individuals of each site (shown in Figure 10.6) with the distribution observed for that period (Figure 10.3) indicate that the perinatal distributions do not differ at the 5% level - the D_{obs} is less than D_{95}.

Period	Site	D_{obs}	D_{95}
Early Anglo-Saxon	Great Chesterford	0.12	0.19
Late Anglo-Saxon	Cherry Hinton	0.06	0.19
Late Anglo-Saxon	Raunds	0.07	0.19
Medieval	Hereford Cathedral	0.08	0.19
Medieval	St. Oswalds, Gloucester	0.10	0.19
Medieval	Stonar	0.16	0.19

Table 10.9: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distributions the sexed perinatal infants from Anglo-Saxon and medieval sites shown in Figure 10.6 with the archaeological and modern distributions Mays (1993) shown in Figure 10.2. Sites with $\mathrm{D}_{\mathrm{obs}}$ equal to or greater than 0.19 have significantly different distributions at the 5% level and are indicated with an asterisk.

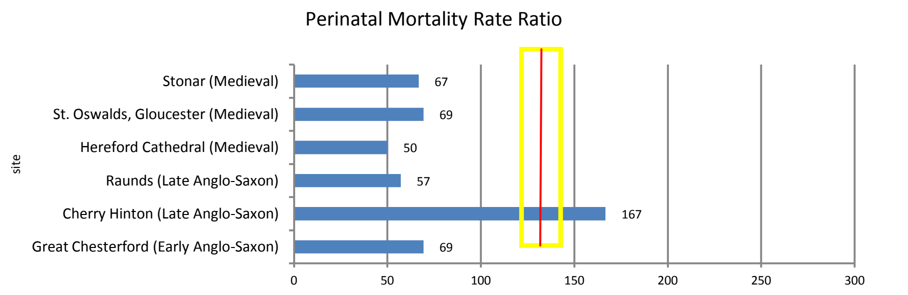
Sites Compared	Great Chesterford (Fig 10.6a)	Cherry Hinton (Fig 10.6b)	Raunds (Fig 10.6c)	Hereford Cathedral (Fig 10.6d)	St.Oswalds Gloucester (Fig 10.6e)	Stonar (Fig 10.6f)
Fig 10.2a. Romano-British Villas	*0.32	*0.22	*0.19	*0.30	0.17	*0.41
Fig 10.2b. Romano-British Cemeteries	0.16	*0.22	0.13	*0.23	*0.19	*0.25
Fig 10.2c. Wharram Percy	*0.26	0.07	0.12	0.11	0.13	0.13
Fig 10.2d. Modern still births	*0.46	*0.25	*0.38	*0.29	*0.26	*0.37
Fig 10.2e. Modern live births dying within 7 days of birth	*0.30	*0.20	*0.27	*0.25	0.16	*0.36
Fig 10.2f. Total modern live births	0.12	*0.27	0.18	*0.22	*0.24	*0.29

From Table 10.9 we see that both of the two late Anglo-Saxon sites, Cherry Hinton and Raunds (Figures 10.6b and 10.6c), are significantly different from the mortality profiles of Figure 10.2d (modern still births) and Figure 10.2e (modern live births dying within seven days of birth). However, Raunds (Figure 10.6c) is not statistically different from the distribution of total modern live births (Figure 10.2f) which would suggest an abnormal mortality profile as the site shows more similarity to the total modern live births than the expected perinatal mortality pattern. The distribution of sexed perinatal infants from the three medieval sites (Figures 10.6d, 10.6e & 10.6f) are all generally well spread across the perinatal age categories. However, from Table 10.9, we see that all three medieval sites (Figures 10.6d, 10.6e & 10.6f) are significantly different from the mortality profiles of modern still births (Figures 10.2d) and total modern live births (Figure 10.2f). Both Hereford (Figure 10.6d) and Stonar (Figure 10.6f) are also significantly different from the profile for modern live births dying within seven days of birth (Figure 10.2e) which could suggest an abnormal mortality profile. Whereas, the St. Oswald, Gloucester (Figure 10.6e) shows some similarity to the total modern live births dying within seven days of birth (Figure 10.2e) and may reflect a natural mortality profile. The results of Kolmogorov-Smirnov two-sample tests comparing the distributions of the sites in each period (see Table 10.10) indicates that the St. Oswald, Gloucester distribution (Figure 10.6e) is also significantly different to the Stonar distribution (Figure 10.6f) at the 5% level ($D_{obs} = 0.26$, D_{95} = 0.19), although neither site differs significantly from the sexed medieval perinatal population (see Table 10.8).

Table 10.10: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the sexed perinatal age distributions for sites shown in Figure 10.6 from each period. Sites with significantly different distributions at the 5% level (D_{obs} is equal to or greater than D_{95}) are indicated with an asterisk.

Period	Sites Compared	D_{obs}	D_{95}
Late Anglo-Saxon	Cherry Hinton & Raunds	0.13	0.19
Medieval	Hereford Cathedral & St. Oswalds, Gloucester	0.14	0.19
Medieval	Hereford Cathedral & Stonar	0.11	0.19
Medieval	St. Oswalds, Gloucester & Stonar	*0.26	0.19

The analysis of the Perinatal Mortality Rate Ratio in Figure 10.7 reveals that none of the six sites have a sex distribution within the expected range. The late Anglo-Saxon site of Cherry Hinton displays a high MRR indicating excess male mortality. The other five sites all have higher than expected proportions of female mortality. Before any interpretations are made from this data it is important to understand that the MRR of the archaeological populations only represents those infants from the site for which sex was identified. As was indicated in Table 10.7, it was not possible to determine the sex of all the perinatal individuals from any of the Anglo-Saxon and medieval sites studied. The main reason for this was poor preservation, with the lack of mandible or ilium preventing sex assessment (in the case of Great Chesterford this caused the exclusion of 64% of perinatal individuals from further analysis). We have already seen the effect that the exclusion of the unsexed perinatal infants can have on a mortality profile in the comparison of Figures 10.1b and 10.3b above. The many problems associated with the representation of infants from archaeological assemblages are further discussed in Chapter 7.



Represents the calculated standard deviation range (114.62-136.47) for the MRR of modern populations.

Represents the calculated mean (125.54) for the MRR of modern populations.

Figure 10.7: Perinatal Morality Rate Ratio by site.

Results of the Analysis of Individuals Aged 0-6 Years

Whilst previous archaeological studies on infanticide have focused on the perinatal individuals, this investigation seeks to compare the sex distributions of the perinatal infants with those of the older infants and children recovered from the same sites to further explore the potential bias of underrepresented assemblages on the mortality profile. A total of 1259 individuals reported to be aged 0-6 years were analysed from 54 Anglo-Saxon and medieval sites. Unfortunately 151 of these individuals did not have the appropriate skeletal elements needed to conduct age assessment to the precision required for this particular research, and as such could not be included in any further analysis. The remaining 1108 individuals were aged using the methods outlined in Chapter 9 into the age categories listed above in Table 9.7. The perinatal individuals are, therefore, now divided into the foetal and neonatal age categories.

The Age and Sex Distribution of Individuals Aged 0-6 Years

The age-at-death distribution of the infants and young children are displayed by period (early Anglo-Saxon, late Anglo-Saxon and medieval) in Figure 10.8, with the age distribution from each site shown in Appendix 5. Both the early and late Anglo-Saxon periods (Figures 10.8a & 10.8b) show the highest concentration of individuals in the Foetal and 1-2 year age categories. These peaks are more prominent for the early Anglo-Saxon period (Figure 10.8a); with the late Anglo-Saxon (Figure 10.8b) distribution being more evenly spread across the age categories. The medieval period age-at-death distribution (Figure 10.8c) has a flatter, more evenly spread, profile with slight peaks at the 1-2 year and 3-4 year category. However, the medieval period (Figure 10.8c) has a smaller proportion of foetal individuals lacking the initial mortality peak visible in both the Anglo-Saxon populations (Figures 10.8a & 10.8b). All three periods have their lowest levels of mortality observed in the 5-6 year age category. The Kolmogorov-Smirnov two-sample test on the age distributions from the three periods (shown in Table 10.11) indicate that whilst none of the distributions significantly differ, statistically the two Anglo-Saxon distributions (Figure 10.8a and 10.8b) have most in common and the early Anglo-Saxon and medieval distributions have less similarities.

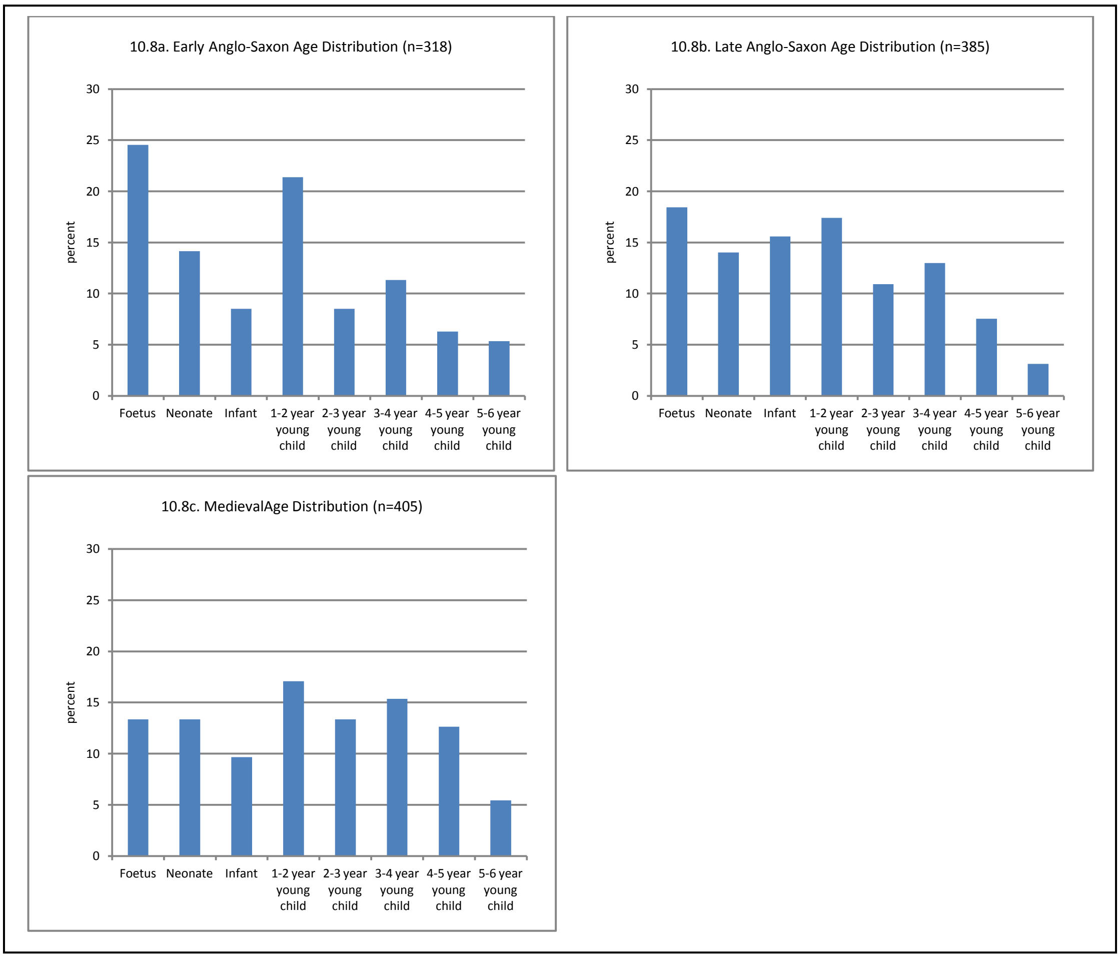


Figure 10.8: Age distribution by period.

Table 10.11: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) on the age distributions shown in Figure 10.8 indicate that the distributions do not differ at the 5% level – in all cases D_{obs} is less than D_{95}.

Periods Compared	D_{obs}	D_{95}
Early Anglo-Saxon & Late Anglo-Saxon	0.06	0.19
Early Anglo-Saxon & Medieval	0.15	0.19
Late Anglo-Saxon & Medieval	0.12	0.19

The results of the sex assessment of the Anglo-Saxon and medieval individuals are shown in Table 10.12 (the distribution for each site can be found in Appendix 5). A total of 1108 0-6 year old individuals were examined from the three periods, however, 293 individuals had no remaining ilium or mandible and so sex assessment could not be performed. Of the 815 individuals that retained sexually diagnostic elements, forty individuals were of indeterminate sex, 439 male, and 336 female.

Table 10.12: Age and sex distribution. The χ^2 test and the Mortality Rate Ratio were performed on the frequencies of Females and Males. As it is only possible to successfully run the chi-square test if the expected value is at least five, the statistic was not used on age categories with less than ten sexed individuals (males and females combined).

Early Anglo-Saxon Sites

Age	Number of Individuals Examined	Individuals with no ilium or mandible	Number of Sexed Individuals	Indeter-minate	Female	Male	χ^2	P=	Mortality Rate Ratio
Foetus	78	50	28	4	11	13	0.17	0.683	118
Neonate	45	21	24	1	16	7	3.52	0.061	44
Infant	27	7	20	0	10	10	0	1	100
1-2 Year Child	68	19	49	1	19	29	2.08	0.149	153
2-3 Year Child	27	12	15	0	6	9	0.60	0.439	150
3-4 Year Child	36	13	23	1	7	15	2.91	0.088	214
4-5 Year Child	20	7	13	4	1	8	-	-	800
5-6 Year Child	17	10	7	0	2	5	-	-	250
Total	318	139	179	11	72	96	3.43	0.064	133

Late Anglo-Saxon Sites

Age	Number of Individuals Examined	Individuals with no ilium or mandible	Number of Sexed Individuals	Indeter-minate	Female	Male	χ^2	P=	Mortality Rate Ratio
Foetus	71	23	48	4	31	13	7.36	**0.007	42
Neonate	54	13	41	2	14	25	3.10	0.078	179
Infant	60	13	47	2	18	27	1.80	0.180	150
1-2 Year Child	67	12	55	3	19	33	3.77	0.052	174
2-3 Year Child	42	9	33	1	9	23	6.13	*0.013	256
3-4 Year Child	50	10	40	6	13	21	1.88	0.170	162
4-5 Year Child	29	3	26	0	4	22	12.46	***0.000	550
5-6 Year Child	12	1	11	0	5	6	0.09	0.763	120
Total	385	84	301	18	113	170	11.48	**0.001	150

Medieval Sites

Age	Number of Individuals Examined	Individuals with no ilium or mandible	Number of Sexed Individuals	Indeter-minate	Female	Male	χ^2	P=	Mortality Rate Ratio
Foetus	54	7	47	2	30	15	5	*0.025	50
Neonate	54	12	42	2	23	17	0.90	0.343	74
Infant	39	15	24	0	13	11	0.17	0.683	85
1-2 Year Child	69	9	60	3	25	32	0.86	0.354	128
2-3 Year Child	54	13	41	1	16	24	1.98	0.160	150
3-4 Year Child	62	9	53	2	18	33	4.41	*0.036	183
4-5 Year Child	51	3	48	0	17	31	4.08	*0.043	182
5-6 Year Child	22	2	20	1	9	10	0.05	0.819	111
Total	405	70	335	11	151	173	1.49	0.222	115

The age distribution of the sexed individuals is displayed in Figure 10.9. Here we see that the exclusion of unsexed individuals has reduced the proportions of foetal individuals for both the early and late Anglo-Saxon periods (Figures 10.9a & 10.9b), thus creating different mortality profiles compared to those of all the aged early and late Anglo-Saxon individuals shown in Figures 10.8a and 10.8b. The Kolmogorov-Smirnov two-sample tests shown in Table 10.13, however, indicate that none of these changes to the distributions are statistically significant. In Figure 10.9 we now see a similar pattern emerging for all three periods (10.9a, 10.9b and 10.9c) whereby the highest proportion of sexed individuals is found for the 1-2 year age category, and the lowest proportion in the 5-6 year category. In Table 10.14 we see that statistically the distributions of the three periods (Figures 10.9a, 10.9b and 10.9c) do not differ at the 5% level, although there is more variation between the early Anglo-Saxon (Figure 10.9a) and medieval (Figure 10.9c) period distributions.

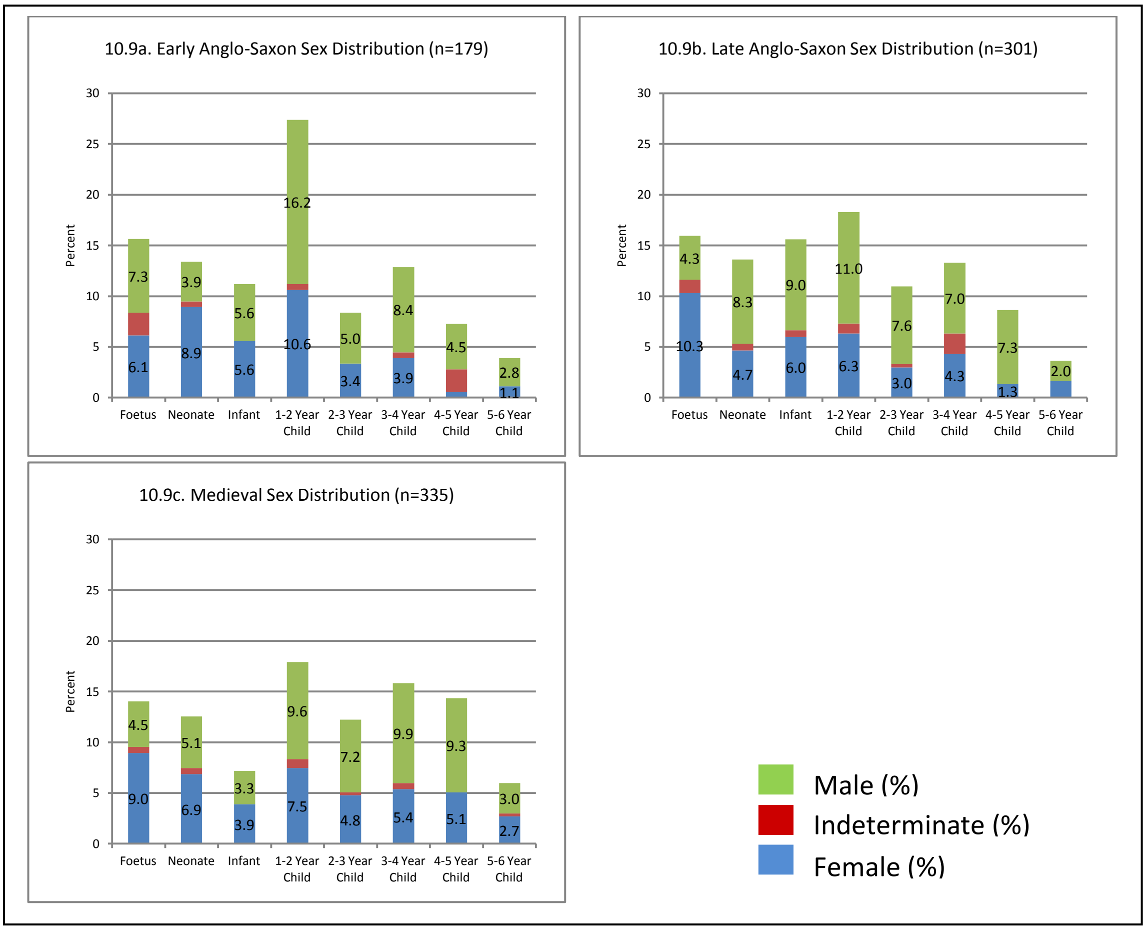


Figure 10.9: Age distribution of sexed individuals by period.

Table 10.13: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the age distributions of all individuals for each period (shown in Figure 10.8) to the age distribution of sexed individuals from each period (Figure 10.9) indicate that the distributions do not differ at the 5% level – D_{obs} is less than D_{95} in all cases.

Period	D_{obs}	D_{95}
Early Anglo-Saxon	0.10	0.19
Late Anglo-Saxon	0.03	0.19
Medieval	0.03	0.19

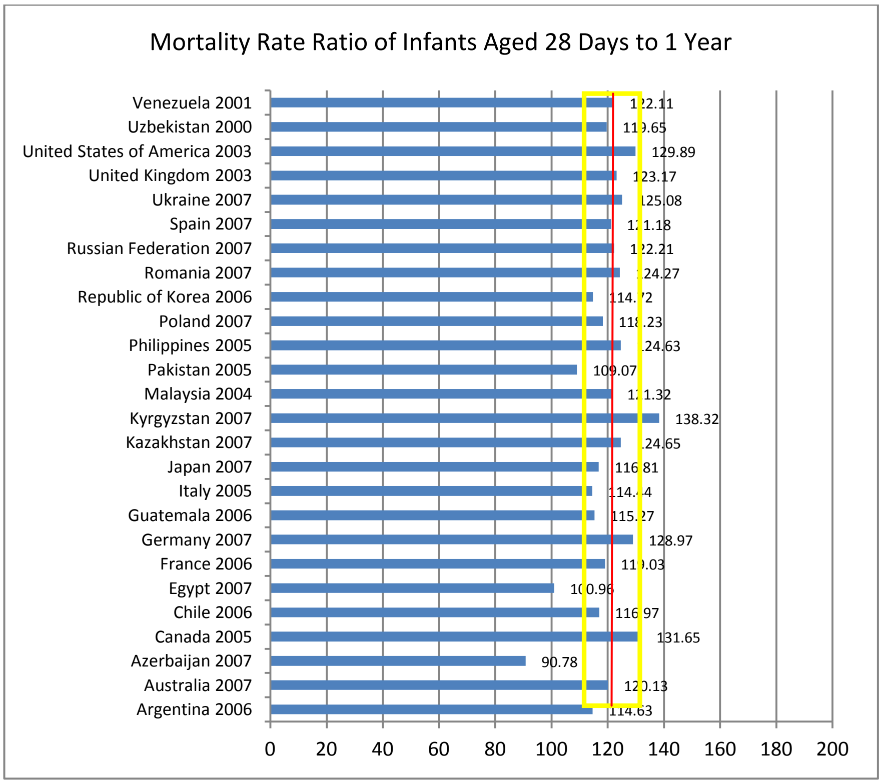
Table 10.14: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) on the age distributions of the sexed individuals shown in Figure 10.9 indicate that the distributions do not differ at the 5% level – D_{obs} is less than D_{95} in all cases.

Periods Compared	D_{obs}	D_{95}
Early Anglo-Saxon & Late Anglo-Saxon	0.05	0.19
Early Anglo-Saxon & Medieval	0.16	0.19
Late Anglo-Saxon & Medieval	0.12	0.19

Looking at the sex distribution for the early Anglo-Saxon period in Figure 10.9a we can see that more males than females are represented in most categories with the exception of the neonate and infant ages, but not to a significant level according to the results of the chi-square tests shown in Table 10.12. In the late Anglo-Saxon period (Figure 10.9b) males are in greater presence than females in all but one of the age categories; with significant chi-square results in the 2-3 year and 4-5 year groups (see Table 10.12). The exception in the late Anglo-Saxon period is the foetal category, which has significantly more females than males represented. However, the chi-square results shown in Table 10.12 indicate that there are a significantly higher proportion of males to females represented in the late Anglo-Saxon period as a whole. The medieval period (Figure 10.9c) shows that there is a greater proportion of females to males represented for the first three age categories (foetal, neonate and infant), significantly so in the foetal category. However, greater male mortality is present for all remaining categories in the medieval period with the chi-square results, shown in Table 10.12, indicating significantly larger proportions of males in the 3-4 and 4-5 year age groups.

The Mortality Rate Ratio of Individuals Aged 0-6 Years

Any further interpretation as to whether the sex distributions of the Anglo-Saxon and medieval individuals reflect a normal mortality profile requires analysis of the Mortality Rate Ratios (MRR) which when compared to modern mortality profiles takes into account the natural biological disadvantage of males. The modern MRR of infant deaths within twenty-seven days of birth is discussed above and shown in Figure 10.4 (the individual male and female Mortality Rates for each country listed in Appendix 4). The MRR of infants aged twenty-eight days to one year from twenty-six modern countries were calculated from the United Nations (2007: Table 16) demographic data and are displayed in Figure 10.10 (the individual male and female mortality rates for each country listed in Appendix 6). The average (mean) MRR of these twenty-six countries is 119.54, with a standard deviation of 9.43. This indicates that on average there are 119.54 male to every 100 female infant deaths within the first month after birth. Therefore, an 'expected' MRR should range from 110.11-128.97, and an MRR below this range can be an indication of excess female childhood mortality.

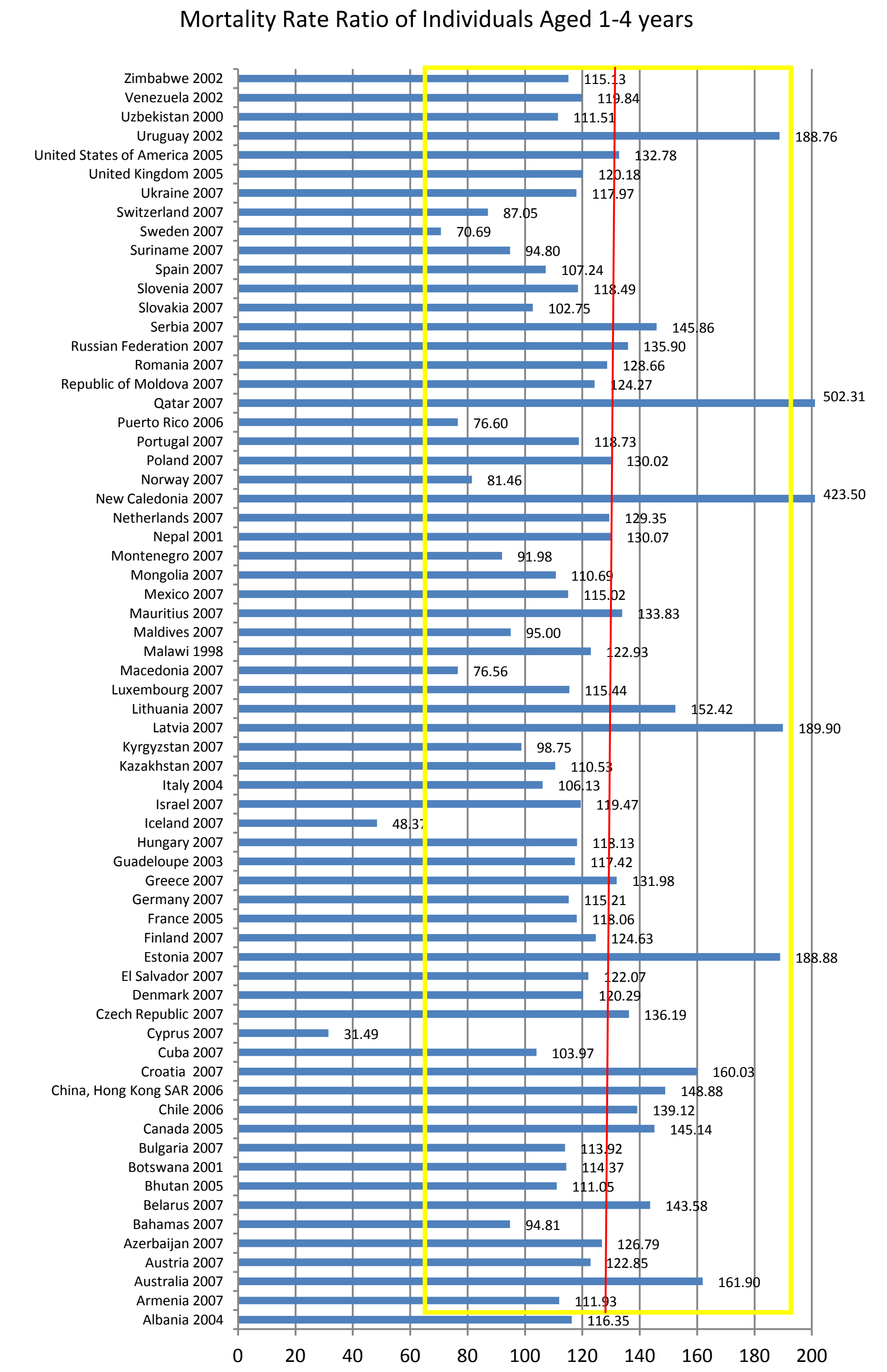


Represents the calculated standard deviation range (110.11-128.97) for the MRR of modern populations.

Represents the calculated mean (119.54) for the MRR of modern populations.

Figure 10.10: Modern national Mortality Rate Ratios for infant deaths from 28 days after birth to one year (after United Nations 2007: Table 16).

The MRR of infants aged one to four years from sixty-six modern countries were calculated from the United Nations (2007: Table 19) demographic data and are displayed in Figure 10.11 (the individual male and female mortality rates for each country listed in Appendix 7). The average (mean) MRR of these sixty-six countries is 129.39, with a standard deviation of 65.88. This indicates that on average there are 129.39 male to every 100 female infant deaths within the first month after birth. Therefore, an 'expected' MRR should range from 63.51-195.28, and an MRR below this range can be an indication of excess female childhood mortality.

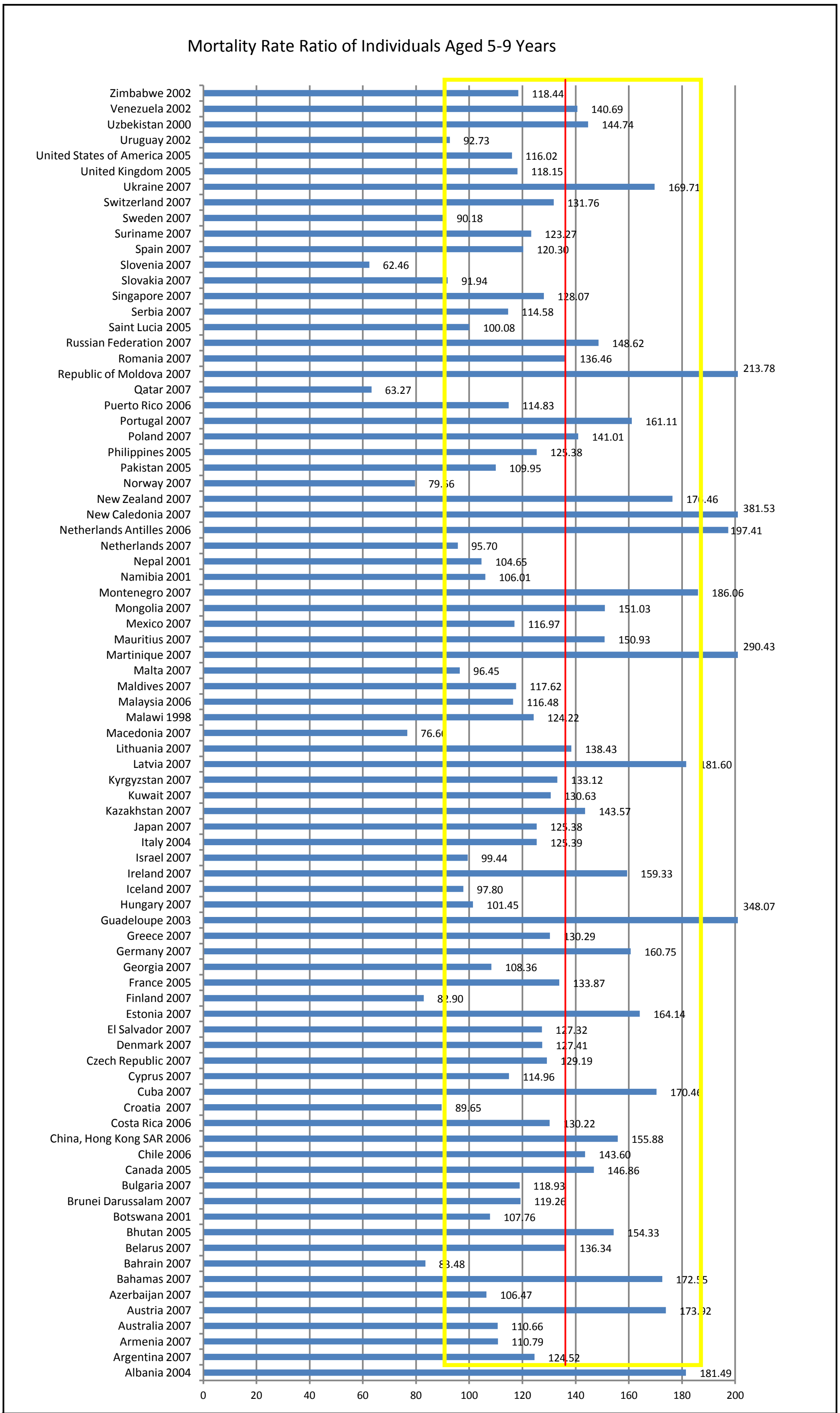


Represents the calculated standard deviation range (63.51-195.28) for the MRR of modern populations.

Represents the calculated mean (129.39) for the MRR of modern populations.

Figure 10.11: Modern national Mortality Rate Ratios for child deaths between one and four years (after United Nations 2007: Table 19).

The MRR of infants aged four to nine years from eighty-three modern countries were calculated from the United Nations (2007: Table 19) demographic data and are displayed in Figure 10.12 (the individual male and female mortality rates for each country listed in Appendix 8). The average (mean) MRR of these eighty-three countries is 135.93, with a standard deviation of 52.31. This indicates that on average there are 135.93 male to every 100 female infant deaths within the first month after birth. Therefore, an 'expected' MRR should range from 83.62-188.24, and an MRR below this range can be an indication of excess female infant mortality.



Represents the calculated standard deviation range (83.62-188.24) for the MRR of modern populations.

Represents the calculated mean (135.93) for the MRR of modern populations.

Figure 10.12: Modern national Mortality Rate Ratios for child deaths between five and nine years (after United Nations 2007: Table 19)

The analysis of the MRR for the early Anglo-Saxon period in Figure 10.13a indicates excess female mortality for the neonatal and infant categories, and excess male mortality in the 3-4, 4-5 and 5-6 year age categories. In Figure 10.13b we see excess female mortality in the foetal category and excess male mortality in the neonatal, infant, 2-3 year and dramatically in the 4-5 year category. The three categories that produced significant results from the chi-square testing shown in Table 10.12, foetus, 2-3 year and 4-5 year, are those with the most abnormal MRR within the late Anglo-Saxon period. The only abnormal MRRs for the medieval period shown in Figure 10.13c (Foetus, Neonate and Infant) all show excess female mortality. Interestingly whilst we can see in Table 10.12 that three categories for this period produced significant chi-square results (Foetus, 3-4 year and 4-5 year) only the Foetus group has an abnormal MRR.

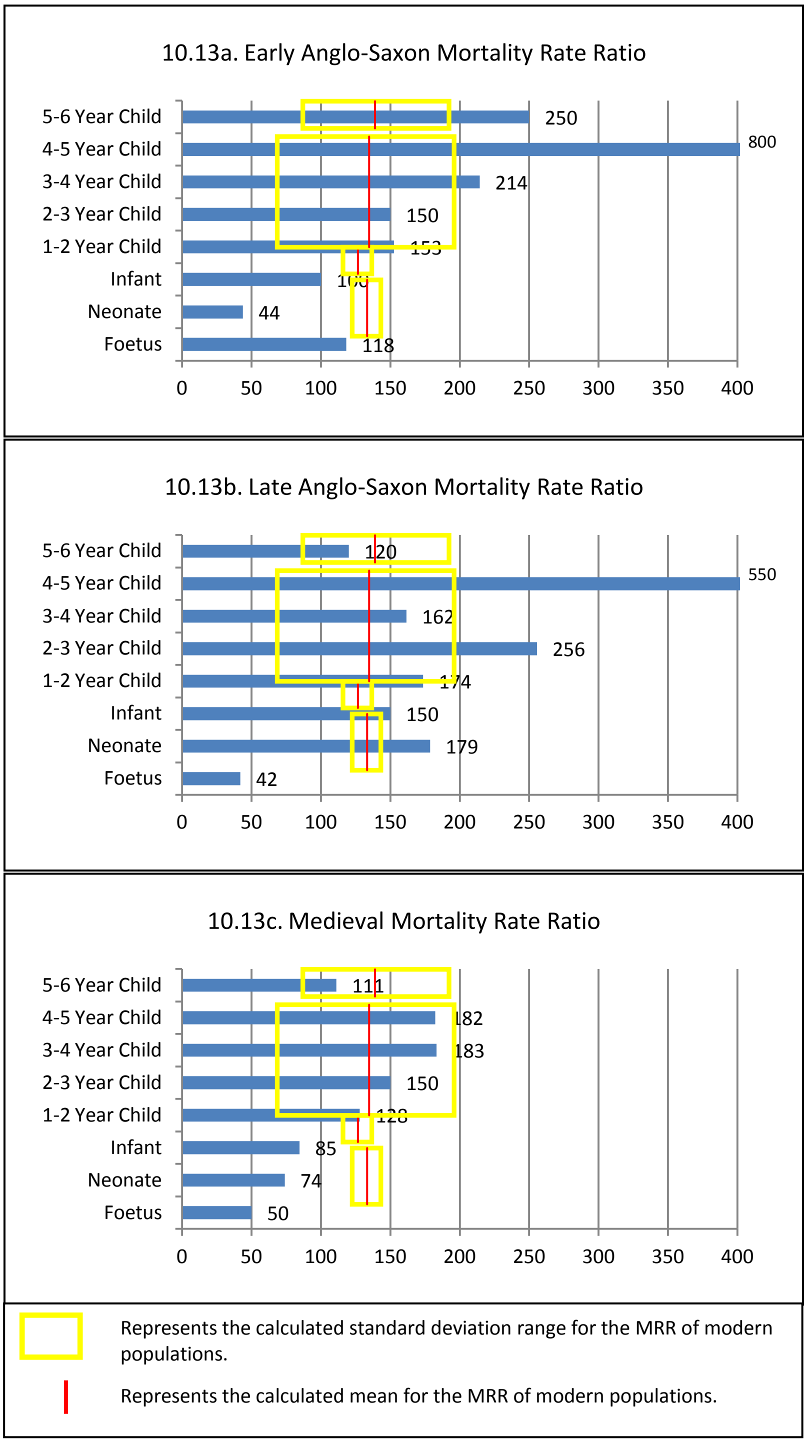


Figure 10.13. Mortality rate ratio by period.

However, as was discussed in Chapter 7, the representation of subadults from the Anglo-Saxon and medieval periods is generally low and it is clear from Table 10.15 that the majority of individuals are in fact only from a small number of sites, as was the case with the perinatal individuals discussed above. This is most apparent in the early Anglo-Saxon period where although a total of twenty three sites were analysed, 73% of the sexed individuals came from only four sites. The late Anglo-Saxon period 96% of the sexed individuals were from half of the sites studied for this period. In the medieval period 86% of the sexed individuals were recorded from ten of the twenty-two sites examined.

Table 10.15: Numbers of sexed individuals from each site.

Early Anglo-Saxon Sites

Site Name	Total	Undetermined sex	Indeterminate sex	Number of Females	Number of Males	Males & Females
Alton, Mount Pleasant	6	2	0	2	2	4
Barrington Edix Hill	2	0	0	1	1	2
Beacon Hill	2	0	1	0	1	1
Bradstow School, Broadstairs	6	5	0	0	1	1
Burwell	4	0	0	1	3	4
Cannington	76	28	4	17	27	44
Dover Buckland	13	12	0	0	1	1
Droxford	2	1	1	0	0	0
Eccles	3	1	0	0	2	2
Finglesham	15	9	1	1	4	5
Great Chesterford	88	48	3	14	23	37
Henley Wood	5	1	0	4	0	4
Holborough	2	1	0	0	1	1
Lechlade Butler's Field	27	2	1	13	11	24
New Wintles	1	0	0	0	1	1
Portway East	5	3	0	1	1	2
Queenford Farm	22	4	0	12	6	18
Redcastle Furze	3	3	0	0	0	0
Stanton Harcourt	4	3	0	0	1	1
Station Road, Gamlingay	20	11	0	4	5	9
Watchfield	1	1	0	0	0	0
Winnall	3	0	0	0	3	3
Worthy Park	8	4	0	2	2	4

Late Anglo-Saxon Sites

Site Name	Total	Undetermined sex	Indeterminate sex	Number of Females	Number of Males	Males & Females
Cherry Hinton	201	53	12	38	98	136
Cirencester Abbey	1	0	0	1	0	1
Norwich North-East Bailey	37	12	1	17	7	24
Nunnaminster	2	0	1	1	0	1
Raunds	99	6	4	37	52	89
Romsey Abbey	8	7	0	1	0	1
St. Oswalds, Gloucester	11	3	0	5	3	8
Staple Gardens	26	3	0	13	10	23

Medieval Sites

Site Name	Total	Undetermined sex	Indeterminate sex	Number of Females	Number of Males	Males & Females
Chichester	57	13	2	18	24	42
Cirencester Abbey	5	0	0	3	2	5
Clopton	10	0	0	3	7	10
Comet Place	28	7	1	7	13	20
Cuddington	19	2	1	7	9	16
East Smithfield	46	1	4	20	21	41
Eynsham Abbey	5	0	0	1	4	5
Gloucester Blackfriars	22	3	0	6	13	19
Guildhall Yard	5	0	0	3	2	5
Hereford Cathedral	69	13	1	31	24	55
Huntington Orchard Lane	5	2	0	1	2	3
Leominster	1	0	0	1	0	1
Market Street, Winchester	2	0	0	0	2	2
New Romney	7	2	0	1	4	5
Spital Square	4	0	0	3	1	4
St Benet Sherehog	3	1	0	0	2	2
St Gregory's Priory Canterbury	7	4	0	1	2	3
St Nicholas Shambles	7	0	0	3	4	7
St. John Clerkenwell	2	0	0	2	0	2
St. Mary Graces	20	3	0	8	9	17
St. Oswalds, Gloucester	37	8	0	18	11	29
Stonar	44	11	2	14	17	31

The Age and Sex Distribution of the Early Anglo-Saxon Sites

Three of the four early Anglo-Saxon sites shown in Figure 10.14 (10.14a, 10.14c and 10.14d) show the highest mortality in the 1-2 year age category, dramatically so in the case of Lechlade Butler's Field (Figure 10.14c). Queenford Farm (Figure 10.14d) displays a slight anomaly in this period with reasonably high proportions of individuals in the 2-3 and 3-4 year age categories, creating a significantly different distribution (see Table 10.16) to that of sexed individuals from the early Anglo-Saxon period as a whole (Figure 10.9a). However, the mortality profile from Great Chesterford (Figure 10.14b) with its high levels of foetal and neonatal mortality is very different from the other three early Anglo-Saxon sites, and from the results of the two-sample Kolmogorov-Smirnov tests shown in Table 10.16 we see that it is statistically different from that of sexed individuals from the early Anglo-Saxon period as a whole (Figure 10.9a). This is further emphasised by the two-sample Kolmogorov-Smirnov results shown in Table 10.17 which indicates that the distribution from Great Chesterford (Figure 10.14b) has the greatest significant differences when statistically compared to the other late Anglo-Saxon sites. However, despite the peak at the 1-2 year age category seen for the other three sites (Figures 10.14a, 10.14c and 10.14d), the two-sample Kolmogorov-Smirnov results shown in Table 10.17 indicate that actually most of the distributions statistically differ at the 5% level – with the exception of Cannington and Lechlade Butler's Field (Figures 10.14a and 10.14c).

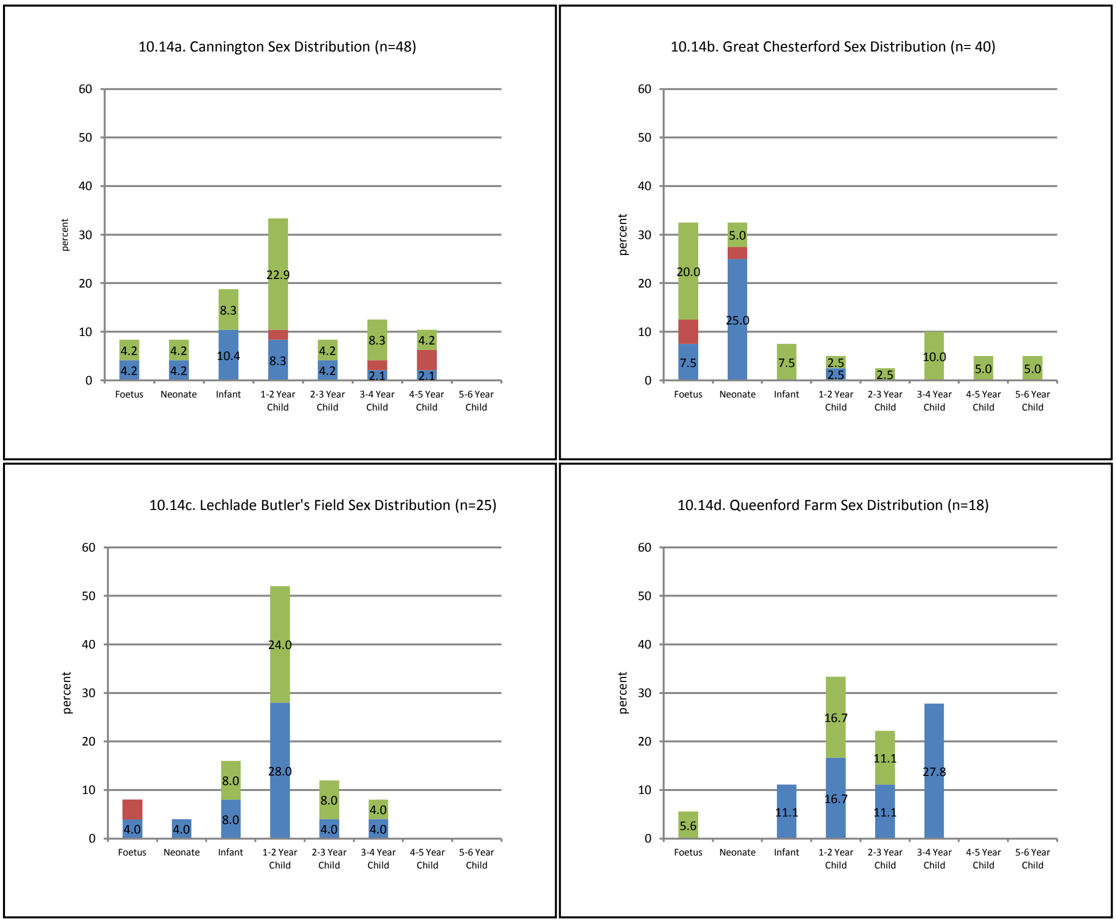


Figure 10.14: Age and sex distribution of Early Anglo-Saxon sites.

Male (%) Indeterminate (%) Female (%)

Table 10.16: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distribution of sexed individuals from the early Anglo-Saxon period (shown in Figure 10.9a) with the distribution observed from each early Anglo-Saxon site (Figure 10.14). Sites with distributions that significantly differ at the 5% level (D_{obs} is equal to or greater than D_{95}) to the distribution for the early Anglo-Saxon period are indicated with an asterisk.

Site	D_{obs}	D_{95}
Cannington	0.12	0.19
Great Chesterford	*0.36	0.19
Lechlade Butler's Field	0.17	0.19
Queenford Farm	*0.24	0.19

Table 10.17: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distributions of sexed individuals for the early Anglo-Saxon sites (shown in Figure 10.14). Sites with distributions that significantly differ at the 5% level (D_{obs} is equal to or greater than D_{95}) are indicated with an asterisk.

Sites Compared	D_{obs}	D_{95}
Cannington & Great Chesterford	*0.48	0.19
Cannington & Lechlade Butler's Field	0.15	0.19
Cannington & Queenford Farm	*0.19	0.19
Great Chesterford & Lechlade Butler's Field	*0.53	0.19
Great Chesterford & Queenford Farm	*0.56	0.19
Lechlade Butler's Field & Queenford Farm	*0.30	0.19

Exploring the sex distribution we see that both Cannington (Figure 10.14a) and Great Chesterford (Figure 10.14b) have generally more male than female mortality. Nevertheless, from examination of the MRR, Cannington (Figure 10.15a) is shown to actually have three age categories with excess female mortality and three categories with excess male mortality. Whereas Great Chesterford (Figure 10.15b) has five age categories displaying excess male mortality, however, the Neonatal category for Great Chesterford has a statistically higher proportion of females (10 females: 2 males χ^2= 5.33, P= 0.021*). The other two early Anglo-Saxon sites, Lechlade Butler's Field (Figure 10.14c) and Queenford Farm (Figure 10.14d), display higher female to male mortality. Both sites only have one age category displaying excess male mortality; the 2-3 year group Lechlade Butler's Field (Figure 10.15c) and Foetus for Queenford Farm (Figure 10.15d). Lechlade Butler's Field (Figure 10.15c) and Queenford Farm (Figure 10.15d) both have two age categories with only females present (providing a MRR equalling 0).

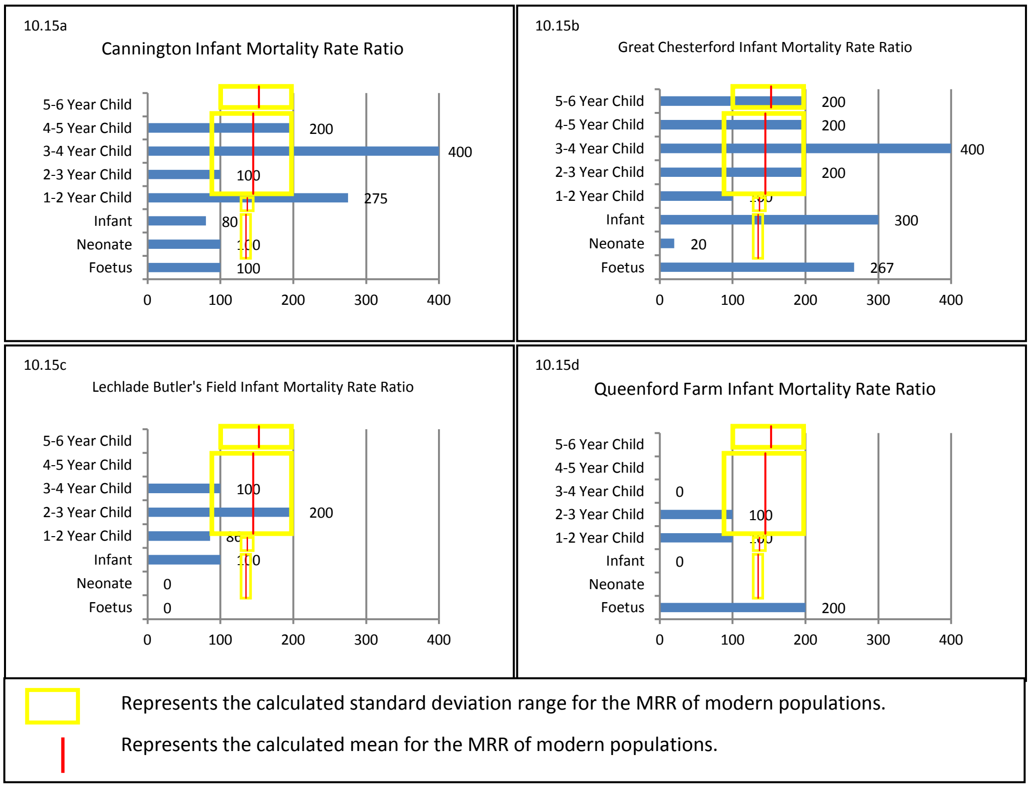


Figure 10.15: Mortality rate ratio of Early Anglo-Saxon sites.

The Age and Sex Distribution of the Late Anglo-Saxon Sites

The age distribution for three of the late Anglo-Saxon sites, Cherry Hinton, Norwich North-East Bailey and Raunds (Figures 10.16a, 10.16b and 10.16c), are fairly evenly spread across the age categories. We see from the results of the two-sample Kolmogorov-Smirnov tests shown in Table 10.18 that none are statistically different to the distribution of all the late Anglo-Saxon sexed individuals (shown in Figure 10.9b). However, Staple Gardens (Figure 10.16d) lacks any individuals from the foetus, 4-5 year and 5-6 year age categories thus increasing the proportions of individuals represented in the central age groups. Although the two-sample Kolmogorov-Smirnov tests shown in Table 10.19 indicate that the Staple Gardens distribution (Figure 10.16d) is only statistically different from that of Raunds (Figure 10.16c).

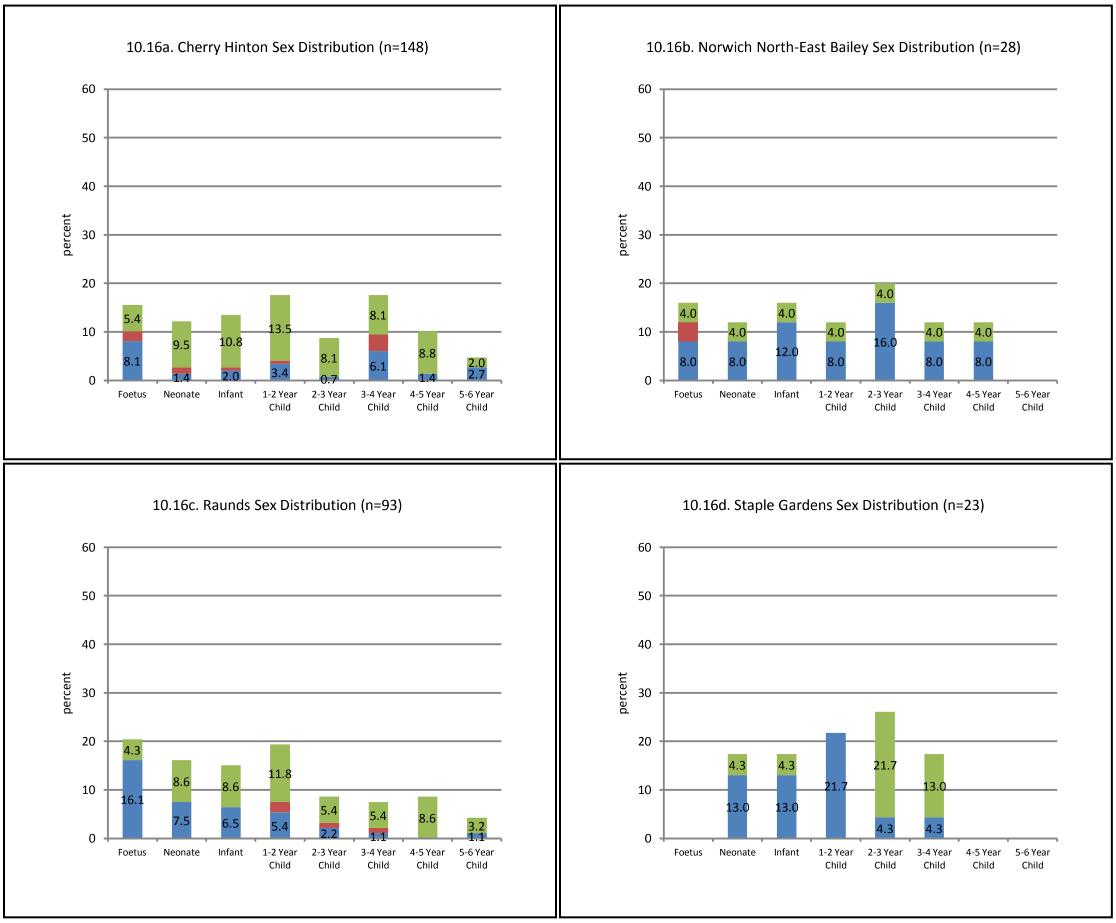


Figure 10.16: Age and sex distribution of Late Anglo-Saxon sites.

Male (%) Indeterminate (%) Female (%)

Table 10.18: The results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distribution of sexed individuals from the late Anglo-Saxon period (shown in Figure 10.9b) with the distribution observed from each late Anglo-Saxon site (Figure 10.16) indicate that the distributions do not differ at the 5% level – D_{obs} is less than D_{95} in all cases.

Site	D_{obs}	D_{95}
Cherry Hinton	0.07	0.19
Norwich North-East Bailey	0.07	0.19
Raunds	0.08	0.19
Staple Gardens	0.16	0.19

Table 10.19: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distributions of sexed individuals for the late Anglo-Saxon sites (shown in Figure 10.16). Sites with distributions that are significantly different at the 5% level (D_{obs} is equal to or greater than D_{95}) are indicated with an asterisk.

Sites Compared	D_{obs}	D_{95}
Cherry Hinton & Norwich North-East Bailey	0.08	0.19
Cherry Hinton & Raunds	0.12	0.19
Cherry Hinton & Staple Gardens	0.16	0.19
Norwich North-East Bailey & Raunds	0.15	0.19
Norwich North-East Bailey & Staple Gardens	0.12	0.19
Raunds & Staple Gardens	*0.20	0.19

Looking at the sex distribution we see that both Cherry Hinton (Figure 10.16a) and Raunds (Figure 10.16c) have higher proportions of males than females represented overall. At Cherry Hinton this is significant with a total of 38 females to 98 males (χ^2=26.47, P= 0.000***). This is emphasised by the MRR for Cherry Hinton shown in Figure 10.17a where we see very high levels of excess male mortality for five of the age categories (Neonate, Infant, 1-2 year, 2-3 year and 4-5 year child), and as is shown in Table 10.20 this is proven to be to a statistically significant level for each group. Raunds (Figure 10.17c) has excess male mortality for the five oldest age categories, however, the reverse is true for the Foetus category which has a significantly higher number of female individuals (15 females: 4 males χ^2=6.37, P= 0.012*).

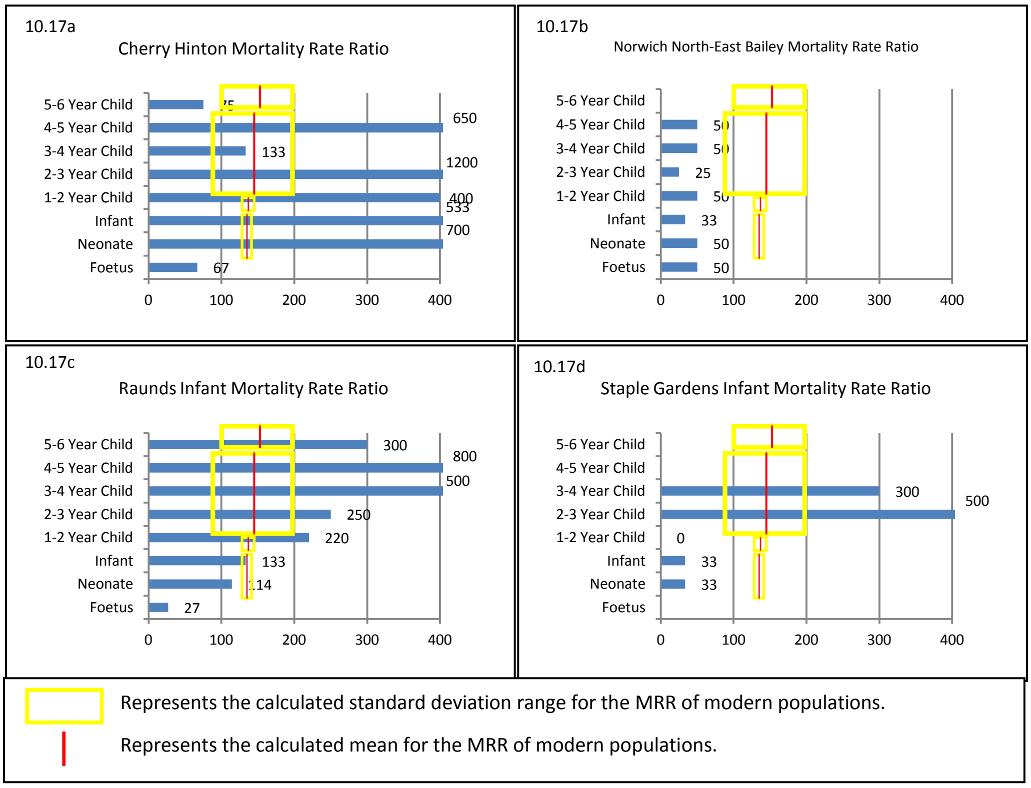


Figure 10.17: Mortality rate ratio of Late Anglo-Saxon sites.

Table 10.20: Representation of the sexes from Cherry Hinton. The Mortality Rate Ratio indicates very high levels of excess male mortality for five of the age categories, which is shown to be statistically significant by the chi-square test.

Age	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Foetus	44	12	8	0.8	0.371	67
Neonate	27	2	14	9	**0.003	700
Infant	26	3	16	8.9	**0.003	533
1-2 Year Child	31	5	20	9	**0.003	400
2-3 Year Child	19	1	12	9.31	**0.002	1200
3-4 Year Child	30	9	12	0.43	0.513	133
4-5 Year Child	16	2	13	8.07	**0.005	650
5-6 Year Child	8	4	3	-	-	75
Total	201	38	98	26.47	***0.000	258

The two remaining late Anglo-Saxon sites; Norwich North-East Bailey and Staple Gardens (Figures 10.16b and 10.16d) both show a higher representation of females to males overall. This is to a significant level at Norwich North-East Bailey with seventeen females to seven males (χ^2=4.17, P= 0.041*), a fact further emphasised by the MRR in Figure 10.17b which indicates excess female mortality in all represented age categories. In comparison, Staple Gardens (Figure 10.17d) shows excess male mortality in two categories and only displays excess female mortality for the three youngest age groups represented.

The Age and Sex Distribution of the Medieval Sites

The majority of the medieval sites shown in Figure 10.18 have a fairly evenly spread of individuals across the age categories following the trend shown in Figure 10.9c. However, there are some anomalies highlighted by the two-sample Kolmogorov-Smirnov tests shown in Table 10.21, which indicates that the distributions of four sites - Clopton, St. Mary Graces, St. Oswalds and Stonar (Figures 10.18b. 10.18h, 10.18i and 10.18j), differ significantly from the distribution of all the sexed medieval individuals shown in Figure 10.9c. Specifically we see that Clopton (shown in Figure 10.18b) has only four of the eight age categories represented which, as the Kolmogorov-Smirnov test shown in Table 10.22 indicates, causes this distribution is statistically different to all the other medieval sites. Both St Oswalds Gloucester and Stonar (Figures 10.18i and 10.18j), which have high representations of the earliest age categories; Foetus and Neonate, also have significantly different distributions to all the other medieval sites including each other (see Table 10.22). St Mary Graces (Figure 10.18h) has a high proportion of individuals from the 4-5 age category which we can see from Table 10.22 creates a significantly different distribution to many of the other medieval sites.

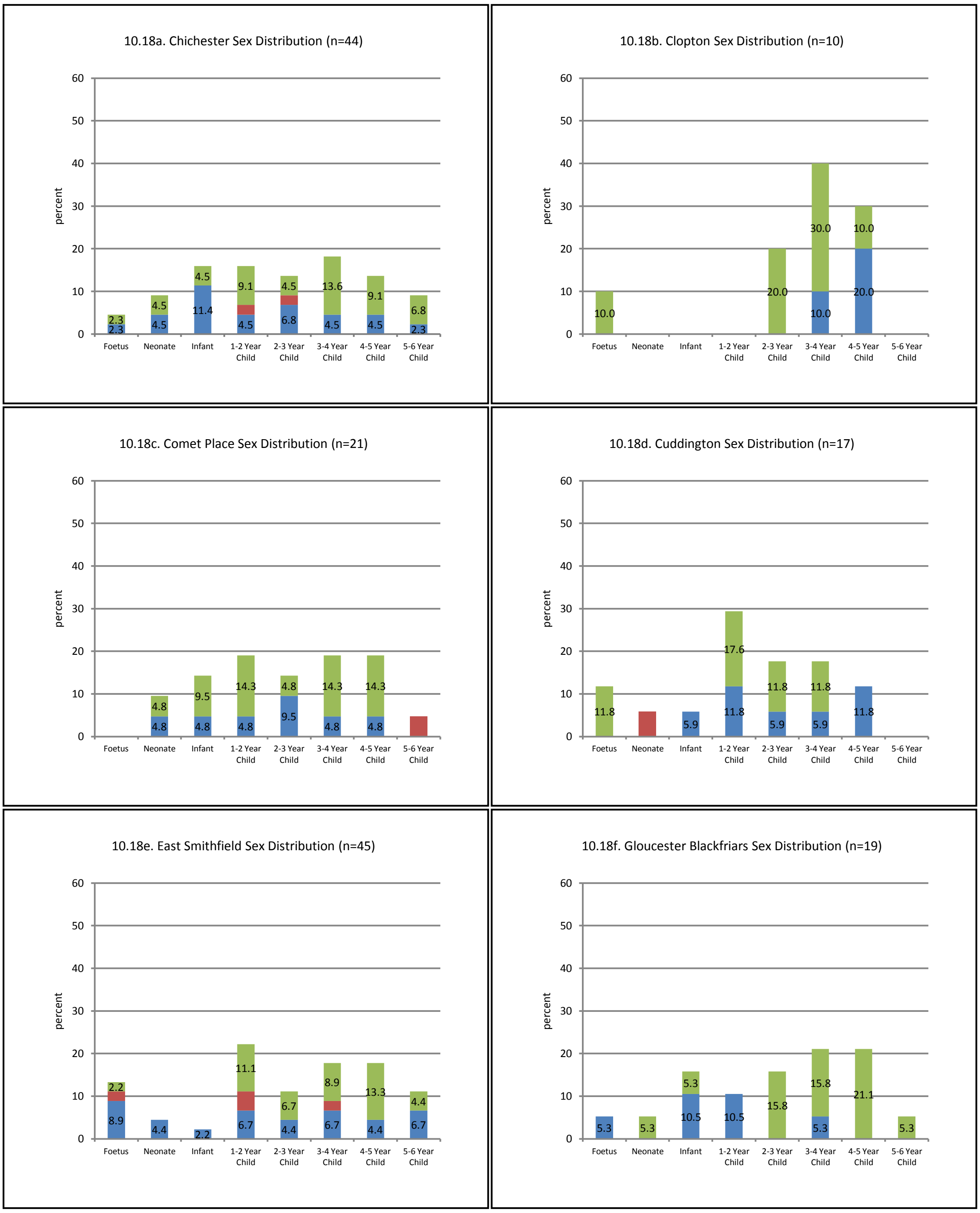


Figure 10.18: Age and sex distribution of medieval sites.

Male (%) Indeterminate (%) Female (%)

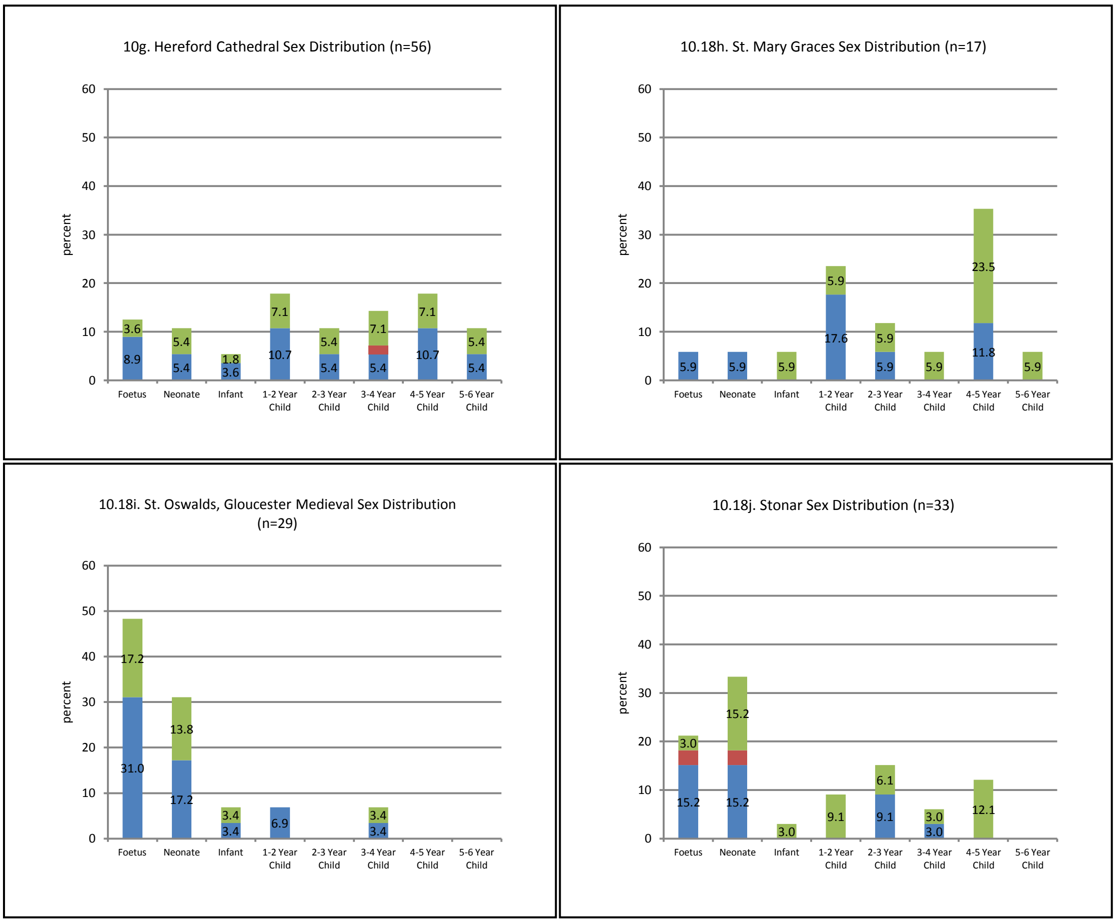


Figure 10.18: Age and sex distribution of medieval sites.

Male (%) Indeterminate (%) Female (%)

Table 10.21: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distribution of sexed individuals from the medieval period (shown in Figure 10.9c) with the distribution observed from each medieval site (Figure 10.18). Sites with distributions that significantly different at the 5% level (D_{obs} is equal to or greater than D_{95}) to the distribution for the medieval period are indicated with an asterisk.

Site	D_{obs}	D_{95}
Chichester	0.13	0.19
Clopton	*0.42	0.19
Comet Place	0.17	0.19
Cuddington	0.10	0.19
East Smithfield	0.14	0.19
Gloucester Blackfriars	0.16	0.19
Hereford Cathedral	0.08	0.19
St. Mary Graces	*0.21	0.19
St. Oswalds, Gloucester	*0.53	0.19
Stonar	*0.28	0.19

Table 10.22: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) comparing the distributions of sexed individuals for the medieval sites (shown in Figure 10.18). Sites with distributions that significantly different at the 5% level (D_{obs} is equal to or greater than D_{95}) are indicated with an asterisk.

Sites Compared	D_{obs}	D_{95}	Sites Compared	D_{obs}	D_{95}
Chichester & Clopton	*0.35	0.19	Cuddington & East Smithfield	0.17	0.19
Chichester & Comet Place	0.06	0.19	Cuddington & Gloucester Blackfriars	0.18	0.19
Chichester & Cuddington	0.11	0.19	Cuddington & Hereford Cathedral	0.17	0.19
Chichester & East Smithfield	0.10	0.19	Cuddington & St. Mary Graces	*0.29	0.19
Chichester & Gloucester Blackfriars	0.09	0.19	Cuddington & St. Oswalds, Gloucester	*0.63	0.19
Chichester & Hereford Cathedral	0.06	0.19	Cuddington & Stonar	*0.37	0.19
Chichester & St. Mary Graces	0.18	0.19	East Smithfield & Gloucester Blackfriars	0.08	0.19
Chichester & St. Oswalds, Gloucester	*0.66	0.19	East Smithfield & Hereford Cathedral	0.09	0.19
Chichester & Stonar	*0.41	0.19	East Smithfield & St. Mary Graces	0.12	0.19
Clopton & Comet Place	*0.33	0.19	East Smithfield & St. Oswalds, Gloucester	*0.66	0.19
Clopton & Cuddington	*0.43	0.19	East Smithfield & Stonar	*0.38	0.19
Clopton & East Smithfield	*0.32	0.19	Gloucester Blackfriars & Hereford Cathedral	0.13	0.19
Clopton & Gloucester Blackfriars	*0.27	0.19	Gloucester Blackfriars & St. Mary Graces	0.15	0.19
Clopton & Hereford Cathedral	*0.36	0.19	Gloucester Blackfriars & St. Oswalds, Gloucester	*0.69	0.19
Clopton & St. Mary Graces	*0.31	0.19	Gloucester Blackfriars & Stonar	*0.44	0.19
Clopton & St. Oswalds, Gloucester	*0.83	0.19	Hereford Cathedral & St. Mary Graces	0.13	0.19
Clopton & Stonar	*0.57	0.19	Hereford Cathedral & St. Oswalds, Gloucester	*0.58	0.19
Comet Place & Cuddington	0.13	0.19	Hereford Cathedral & Stonar	*0.31	0.19
Comet Place & East Smithfield	0.13	0.19	St. Mary Graces & St. Oswalds, Gloucester	*0.29	0.19
Comet Place & Gloucester Blackfriars	0.06	0.19	St. Mary Graces & Stonar	*0.43	0.19
Comet Place & Hereford Cathedral	0.14	0.19	St. Oswalds, Gloucester & Stonar	*0.29	0.19
Comet Place & St. Mary Graces	0.17	0.19			
Comet Place & St. Oswalds, Gloucester	*0.70	0.19			
Comet Place & Stonar	*0.45	0.19			

Most of the medieval sites have higher proportions of males to females with only two of the ten sites, Hereford Cathedral and St Oswalds Gloucester (Figures 10.18g and 10.18i), having an overall higher representation of females than males. Examining the MRR we can see that both Hereford Cathedral and St Oswalds Gloucester (Figures 10.19g and 10.19i) are the only sites to have all represented age categories below the expected average MRR, although excess female mortality is only implied for some, not all, of these categories. The highest level of excess male mortality is seen in the 4-5 year category at both Gloucester Blackfriars and Stonar (Figures 10.19f and 10.19j), in both cases, four males but no females represented. There is a slight trend with the medieval sites shown in Figure 10.19 whereby excess female mortality is more apparent in the earlier age groups and excess male mortality in the older age groups.

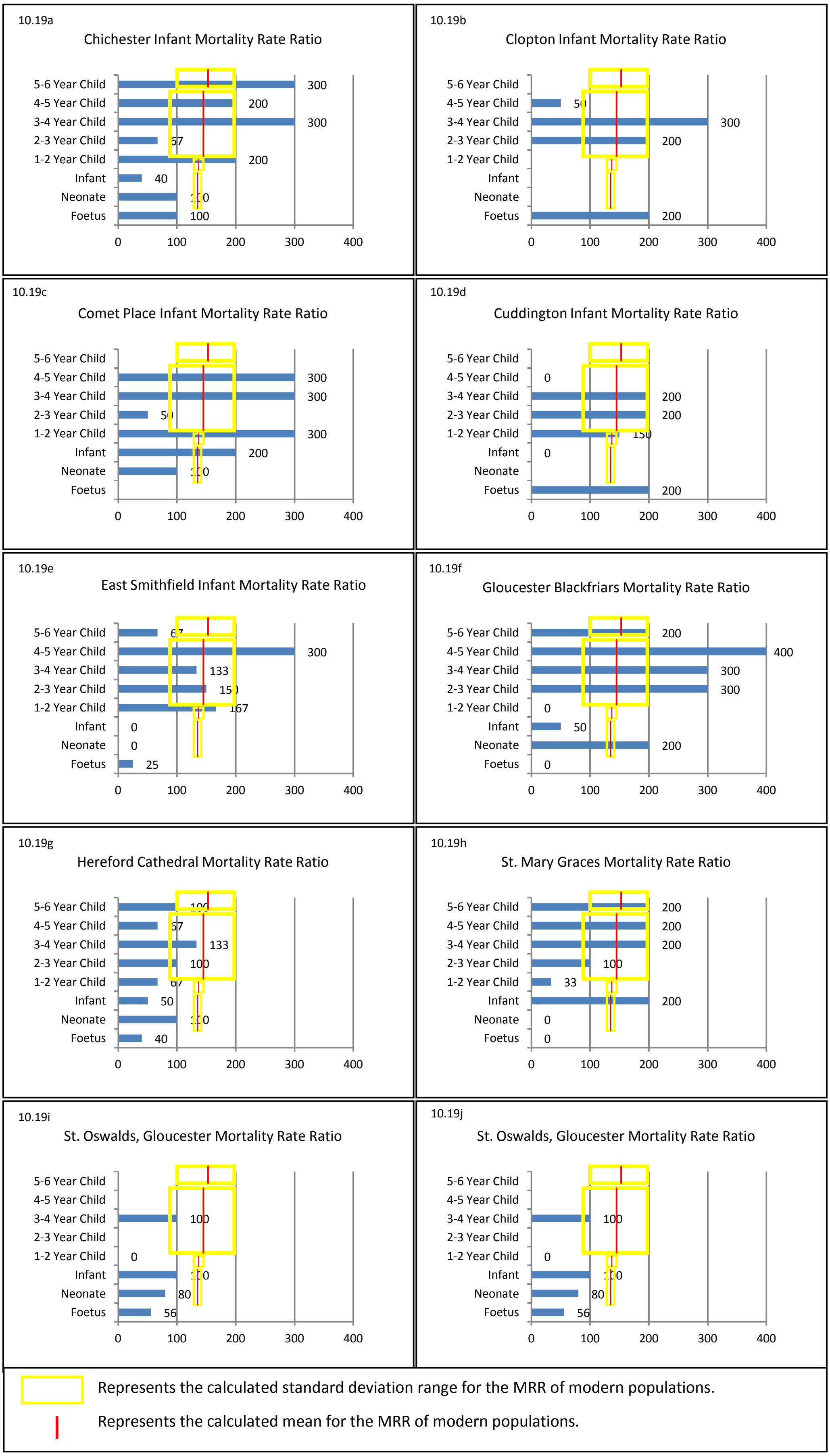


Figure 10.19: Mortality rate ratio of medieval sites.

Results of the Palaeopathological Analysis

The individuals in this study were examined for the presence of any visible pathology, where a short description of the location and appearance of the lesion was recorded; the observations for each individual displaying pathological changes can be found in Appendix 9. The total age and sex distribution of the individuals displaying pathological changes for each period is shown in Table 10.23. A chi-square test was performed for each age category, as well as the total number of males and females for each period, to determine if there was a statistically significant difference in the number of individuals from each sex displaying pathological changes (see Table 10.23). It is only possible to successfully run the chi-square test if the expected value is at least five, therefore the statistic was not used on age categories with less than ten sexed individuals (males and females combined). Here we see that all three periods have a higher number of males with pathological changes to females, although this is only statistically significant in the late Anglo-Saxon period. However, the late Anglo-Saxon period also has a significantly higher number of females displaying pathological changes recovered from the foetal category.

Table 10.23 also indicates that all three periods have their highest number of individuals displaying pathological changes (Total N) in the 1-2 year age category. However, the number of individuals displaying pathological changes is greatly influenced by the large sample size recovered for this age group (Total number of aged individuals). To overcome this biasing effect of sample size the crude prevalence rate is used (shown in Table 10.23 as Total %), this is where the number of individuals displaying pathological changes in each age category is divided by the total number of individuals recovered for that age category and expressed as a percentage.

Table 10.23: Age and sex distribution of individuals displaying pathological changes.
Total % = the crude prevalence rate of individuals displaying pathological changes for age category. As it is only possible to successfully run the chi-square test if the expected value is at least five, the statistic was not used on age categories with less than ten sexed individuals (males and females combined).

Early Anglo-Saxon

Age	Total number of aged individuals	Individuals with Pathological Changes							
		Total N	Total %	Undetermined	Indeterminate	Female	Male	χ^2	P=
Foetus	78	6	8	2	0	2	2	-	-
Neonate	45	15	33	5	1	6	3	-	-
Infant	27	7	26	1	0	5	1	-	-
1-2 Year Child	68	23	34	4	0	8	11	0.474	0.491
2-3 Year Child	27	6	22	4	0	1	1	-	-
3-4 Year Child	36	9	25	2	1	2	4	-	-
4-5 Year Child	20	7	35	1	1	1	4	-	-
5-6 Year Child	17	0	0	0	0	0	0		
Total	318	73	23	19	3	25	26	0.02	0.889

Late Anglo-Saxon

Age	Total number of aged individuals	Individuals with Pathological Changes							
		Total N	Total %	Undetermined	Indeterminate	Female	Male	χ^2	P=
Foetus	71	21	30	2	1	14	4	5.556	*0.018
Neonate	54	19	35	4	0	6	9	0.6	0.439
Infant	60	14	23	3	0	4	7	0.818	0.366
1-2 Year Child	67	33	49	1	2	12	18	1.2	0.273
2-3 Year Child	42	11	26	0	1	3	7	1.6	0.206
3-4 Year Child	50	29	58	5	4	8	12	0.8	0.371
4-5 Year Child	29	11	38	1	0	0	10	10	**0.002
5-6 Year Child	12	6	50	0	0	2	4	-	-
Total	385	144	37	16	8	49	71	4.033	*0.045

Medieval

Age	Total number of aged individuals	Individuals with Pathological Changes							
		Total N	Total %	Undetermined	Indeterminate	Female	Male	χ^2	P=
Foetus	54	5	9	0	0	3	2	-	-
Neonate	54	14	26	1	0	6	7	0.077	0.782
Infant	39	6	15	0	0	5	1	-	-
1-2 Year Child	69	23	33	3	0	9	11	0.2	0.655
2-3 Year Child	54	16	30	1	1	5	9	1.143	0.285
3-4 Year Child	62	17	27	2	1	6	8	0.286	0.593
4-5 Year Child	51	12	24	1	0	3	8	2.273	0.132
5-6 Year Child	22	9	41	1	0	3	5	-	-
Total	405	102	25	9	2	40	51	1.087	0.297

The distribution of the crude prevalence rate for the individuals displaying pathological changes (shown in Figure 10.20) suggests that the late Anglo-Saxon period has the highest proportion of individuals displaying pathological changes, reaching 58% in the 3-4 year age category. There does not appear to be any one age category that has more individuals displaying pathological changes than the others for all three periods, with reasonably high levels of pathology being observed for most ages. Nevertheless, the Kolmogorov-Smirnov tests shown in Table 10.24 indicate that the early Anglo-Saxon and medieval distributions statistically differ at the 5% level, this is probably due to differences in the 5-6 year category which is high for the medieval period but for which there is an absence of individuals displaying pathological changes in the early Anglo-Saxon period.

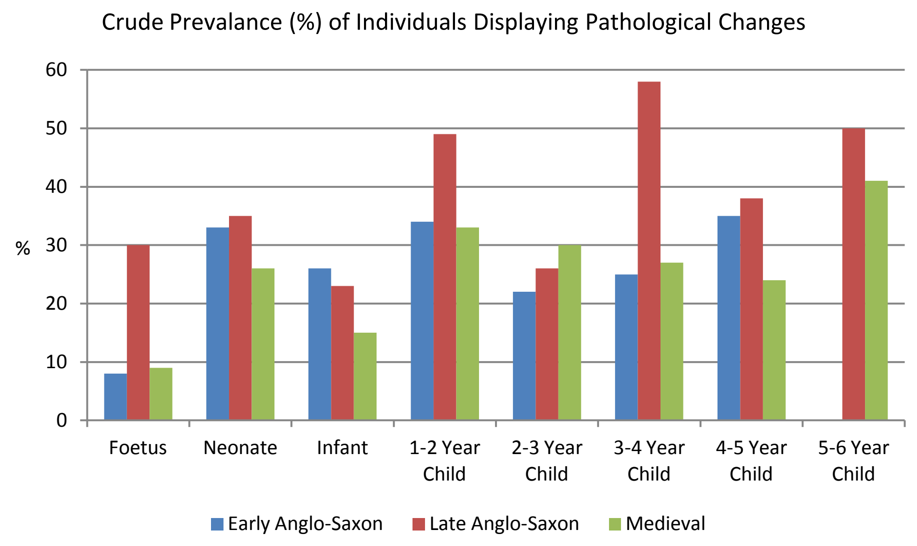


Figure 10.20: Crude prevalence of the individuals displaying pathological changes by period.

Table 10.24: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) on the age distributions of the crude prevalence rate of individuals displaying pathological changes shown in Figure 10.20. Distributions that statistically differ at the 5% level (D_{obs} is equal to or greater than D_{95}) are indicated with an asterisk.

Periods Compared	D_{obs}	D_{95}
Early Anglo-Saxon & Late Anglo-Saxon	0.16	0.19
Early Anglo-Saxon & Medieval	*0.20	0.19
Late Anglo-Saxon & Medieval	0.05	0.19

Figure 10.21 shows the crude prevalence of individuals displaying pathological changes recovered from sites with larger mortality populations, the distribution from each site is presented in Appendix 10. In an attempt to prevent any bias such as over

inflated crude prevalence rates that would be caused by sites with small sample sizes, the sites shown in Figure 10.21 all have more than fifteen individuals represented in the total aged burial population. In Figure 10.21 we see that at only 4% and 3%, Comet Place and medieval St Oswalds Gloucester both have a low prevalence of pathology (one pathological individual out of 28 was recovered from the former and one out of 37 from the latter). As both sites have fair (St Oswalds) or even good (Comet Place) preservation, another explanation must be sought for the low prevalence rates observed. One argument is that the individuals from these sites were generally healthy with few morbidity issues; however the osteological paradox suggests the possibility that individuals from these sites in fact had a low immunological reaction and subsequently died before skeletal response to morbidity could develop. At the other end of the scale, high levels of observed pathology are recorded from Station Road Gamlingay (nine individuals displaying pathological changes out of 20), Raunds (67/99) and Chichester (30/57) with crude prevalence rates above forty percent at 45%, 68% and 53% respectively.

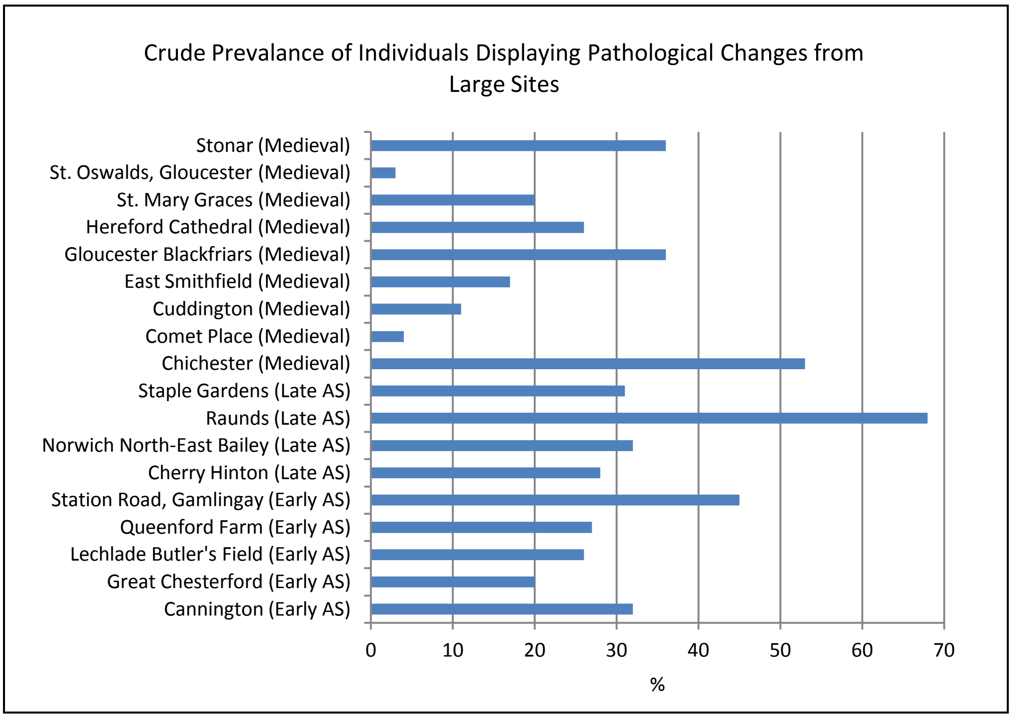


Figure 10.21: Crude prevalence of individuals displaying pathological changes from sites with a total number of aged individuals greater than fifteen.

The total number of individuals displaying pathological changes, as discussed above, includes all individuals with any visible pathology recorded. However, because individuals can display more than one pathological lesion at a time, the pathologies were also analysed by frequency of occurrence. For example, if a single individual displayed cribra orbitalia, endocranial lesions and dental caries, the three separate pathologies were recorded under the three appropriate diagnoses. The observed pathological lesions fell into a small number of categories: those suggesting non-specific conditions (periosteal reaction, endocranial lesions, ectocranial lesions, cribra orbitalia, enamel hypoplasia and caries). For some individuals the pattern of pathological lesions also suggested a specific aetiology including metabolic diseases (scurvy and rickets) and infectious disease (tuberculosis). For the age and sex distribution of pathologies for each period see Appendix 11 and Appendix 12 for the prevalence of pathology at each site.

Figure 10.22 displays the distribution of non-specific indicators from the three periods. Here we see again that the late Anglo-Saxon period shown in Figure 10.22b has a higher prevalence of observed pathology than the other two periods. The distribution of pathologies is well spread for each of the periods with no one age group displaying a much higher degree of stress than the others. However, the results of the Kolmogorov-Smirnov two-sample tests shown in Table 10.25 indicate that the early Anglo-Saxon distribution for three of the non-specific indicators (periosteal reactions, ectocranial lesions and cribra orbitalia) differs significantly from those of the other two periods, this is mainly due to the lack of individuals in the early Anglo-Saxon 5-6 year age category. The most prevalent non-specific stress indicator observed for all three periods is cribra orbitalia, which tends to be observed in greater proportions in the older age categories. Endocranial lesions were observed for all age categories with recovered individuals displaying pathological changes, however, there does not appear to be a trend in the age of observed individual. Periosteal reactions are observed for most age groups but for all three periods it is most prevalent in the neonatal category, yet despite this we see in Table 10.25 that the distributions for all three periods are statistically different. Ectocranial lesions, whilst observed in all age groups, appears to be more commonly observed in the 1-2 year and 5-6 year categories (only in the 1-2 year category for the early Anglo-Saxon period; see Figure 10.22a). Enamel hypoplasia was only observed in low levels from the late Anglo-Saxon and medieval periods (Figures 10.22b and 10.22c) and caries only in the medieval period.

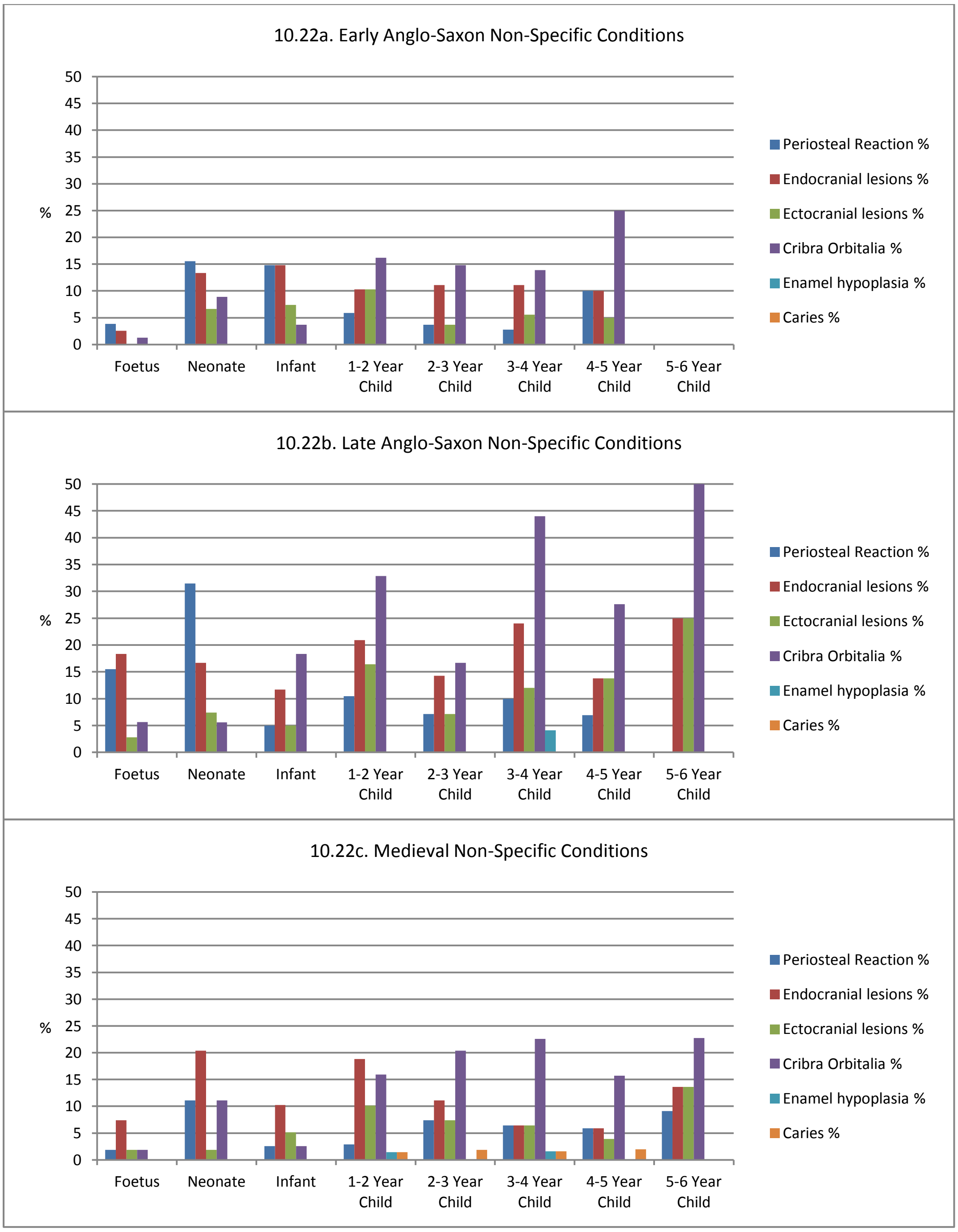


Figure 10.22: The age distribution of the crude prevalence rate of nonspecific conditions.

Table 10.25: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) on the age distributions of the crude prevalence rates of non specific conditions shown in Figure 10.22. Distributions that statistically differ at the 5% level (D_{obs} is equal to or greater than D_{95}) are indicated with an asterisk.

Non Specific Condition	Periods Compared	D_{obs}	D_{95}
Periosteal Reaction	Early Anglo-Saxon & Late Anglo-Saxon	*0.20	0.19
	Early Anglo-Saxon & Medieval	*0.30	0.19
	Late Anglo-Saxon & Medieval	*0.31	0.19
Endocranial lesions	Early Anglo-Saxon & Late Anglo-Saxon	0.17	0.19
	Early Anglo-Saxon & Medieval	0.15	0.19
	Late Anglo-Saxon & Medieval	0.16	0.19
Ectocranial lesions	Early Anglo-Saxon & Late Anglo-Saxon	*0.31	0.19
	Early Anglo-Saxon & Medieval	*0.28	0.19
	Late Anglo-Saxon & Medieval	0.09	0.19
Cribra Orbitalia	Early Anglo-Saxon & Late Anglo-Saxon	*0.25	0.19
	Early Anglo-Saxon & Medieval	*0.20	0.19
	Late Anglo-Saxon & Medieval	0.06	0.19
Enamel hypoplasia	Late Anglo-Saxon & Medieval	*0.33	0.19

Figure 10.23 displays the age distribution of prevalence of probable cases of rickets, scurvy and tuberculosis. In all three periods scurvy is the most prevalent of the three diseases, with higher levels recorded from the later Anglo-Saxon individuals, shown in Figure 10.23b. However, results of the two-sample Kolmogorov-Smirnov test shown in Table 10.26 indicate that the age distribution of scurvy is statistically different for each of the periods. Possible rickets is observed from all three periods but is in greater prevalence in the early Anglo-Saxon period (Figure 10.23a) although the distributions are again significantly different for all three periods (see Table 10.26). Tuberculosis is only recorded in the early Anglo-Saxon and the medieval periods (Figures 10.23a and 10.23c) with the greater prevalence in the 4-5 year age category, although even here the proportions of observed individuals displaying pathological changes is low.

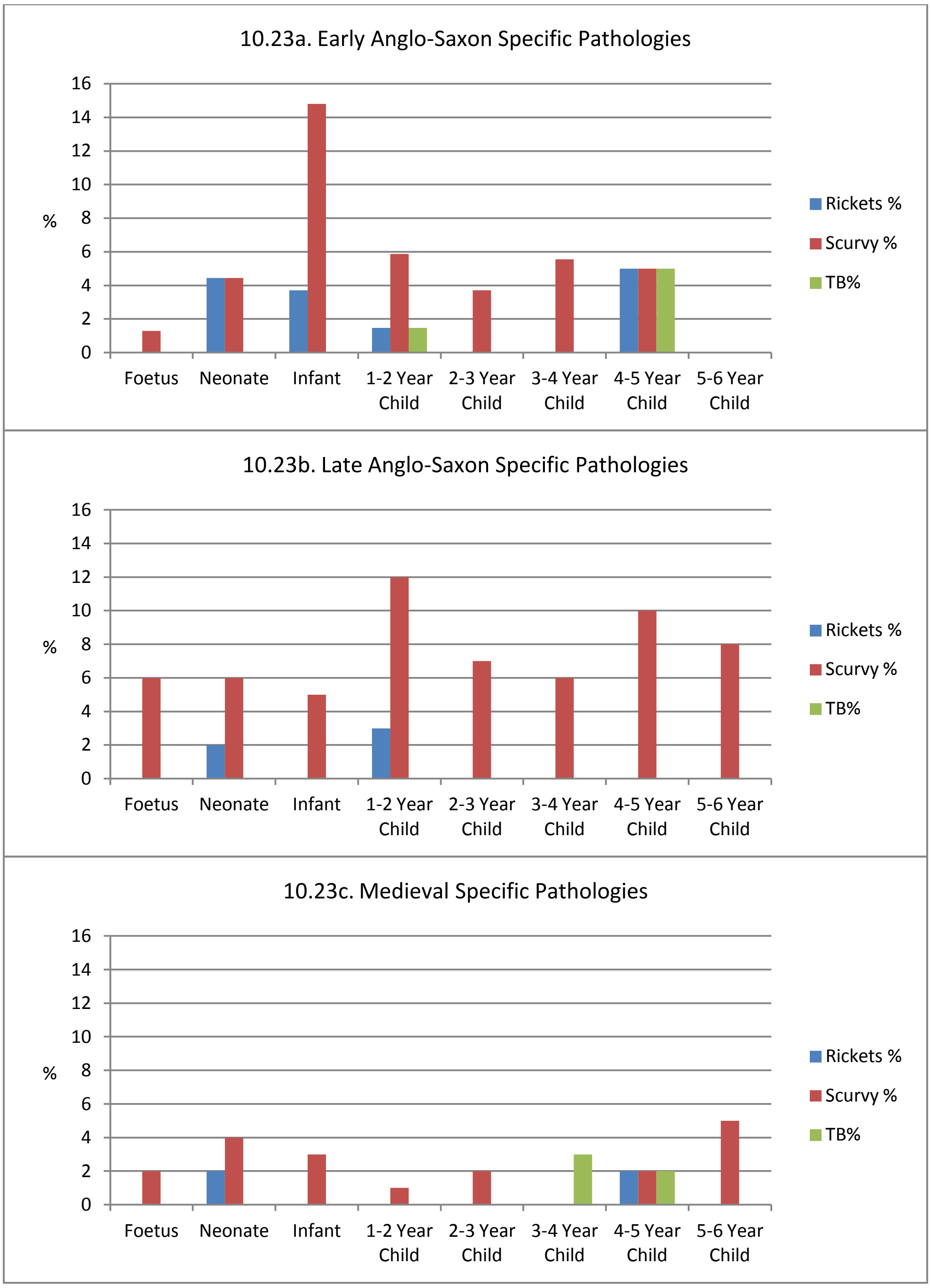


Figure 10.23: The age distribution of the crude prevalence rate of specific pathologies.

Table 10.26: Results of Kolmogorov-Smirnov two-sample test (Siegel 1956: 131) on the age distributions of the crude prevalence rates of specific pathologies shown in Figure 10.23. Distributions that statistically differ at the 5% level (D_{obs} is equal to or greater than D_{95}) are indicated with an asterisk.

Pathology	Periods Compared	D_{obs}	D_{95}
Rickets	Early Anglo-Saxon & Late Anglo-Saxon	*0.36	0.19
	Early Anglo-Saxon & Medieval	*0.21	0.19
	Late Anglo-Saxon & Medieval	*0.50	0.19
Scurvy	Early Anglo-Saxon & Late Anglo-Saxon	*0.20	0.19
	Early Anglo-Saxon & Medieval	*0.26	0.19
	Late Anglo-Saxon & Medieval	*0.19	0.19
Tuberculosis	Early Anglo-Saxon & Medieval	*0.43	0.19

Figure 10.24 displays the distribution of nonspecific infection observed from the larger sites. Here we see that the site with the largest prevalence of observed pathological indicators is late Anglo-Saxon Raunds (Figure 10.24b) with very high levels of periosteal reaction, endocranial lesions and cribra orbitalia. However, in general, cribra orbitalia is the most observed indicator from the late Anglo-Saxon sites (Figure 10.24b). The site displaying the highest prevalence of non-specific infection in the early Anglo-Saxon period is Station Road Gamlingay (Figure 10.24a), which has fairly high proportions of periosteal reaction and endocranial lesions. However, the prevalence of endocranial lesions at Queenford Farm is the highest observed indicator for the early Anglo-Saxon period, and generally endocranial lesions are the most prevalent category of non-specific infection recorded for this period. In the medieval period (Figure 10.24c) we see that Chichester displays the highest overall prevalence of nonspecific infection pathology, with high proportions also recorded for Stonar and Gloucester Blackfriars. Endocranial lesions and cribra orbitalia are the two highest prevalent stress indicators recorded for the medieval period with observations from all the sites shown in Figure 10.24c. Only Gloucester Blackfriars and Hereford Cathedral have any recorded incidence of caries or enamel hypoplasia from this period.

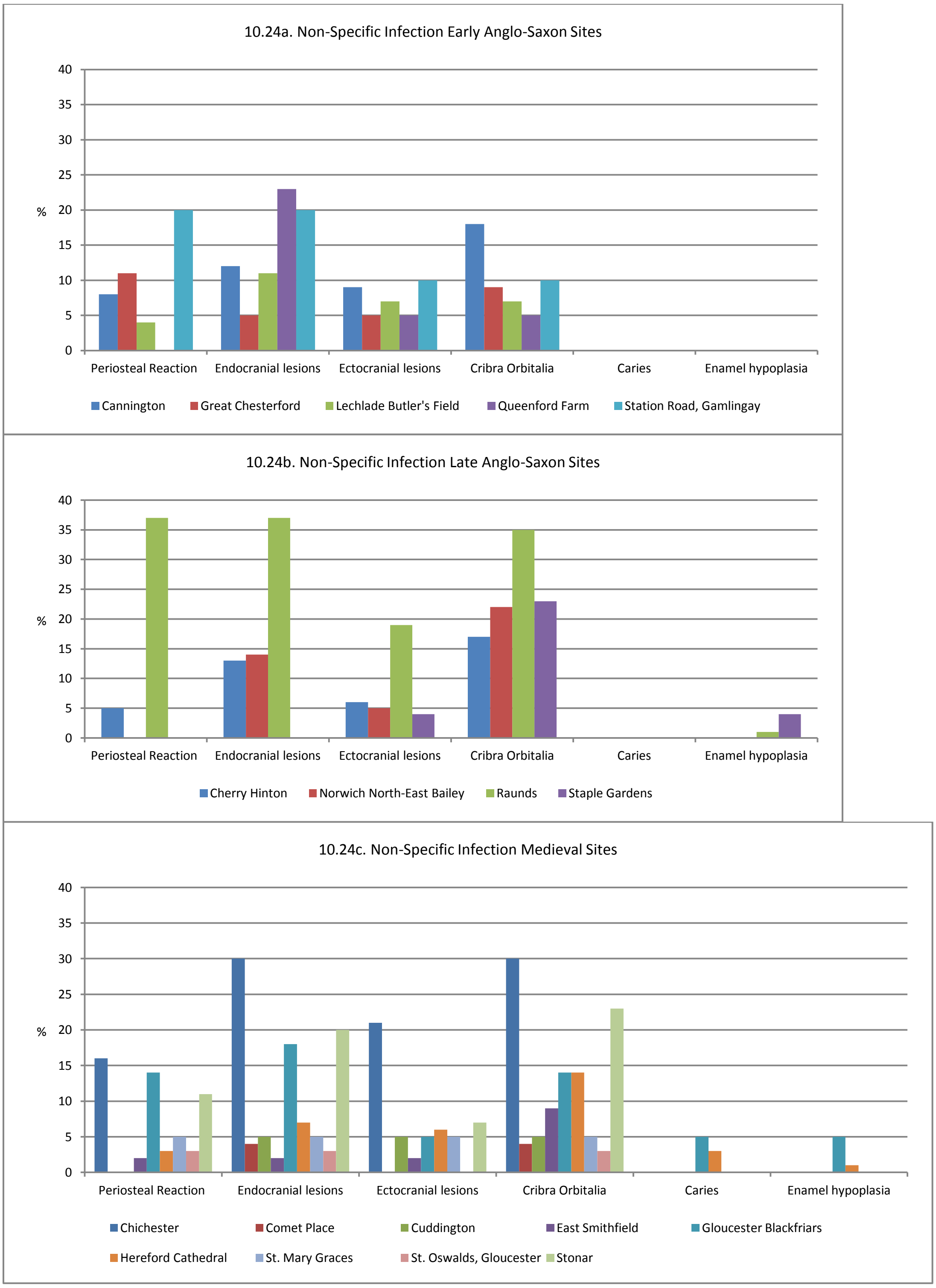


Figure 10.24: The distribution of the crude prevalence rate of pathologies suggestive of nonspecific infection from larger sites.

Not all of the larger sites display probable cases of rickets, scurvy and tuberculosis; nevertheless of those that do (shown in Figure 10.25) scurvy is the disease most commonly observed in all three periods. The highest prevalence of scurvy is observed at the late Anglo-Saxon Raunds (Figure 10.25b) followed by early Anglo-Saxon Station Road Gamlingay (Figure 10.25a) and medieval Chichester (Figure 10.25c). A low level of probable rickets is observed from all three periods with the highest prevalence at early Anglo-Saxon Station Road Gamlingay. Low levels of tuberculosis are only recorded from four sites early Anglo Saxon Great Chesterford, and three from the medieval period Chichester, East Smithfield and Stonar.

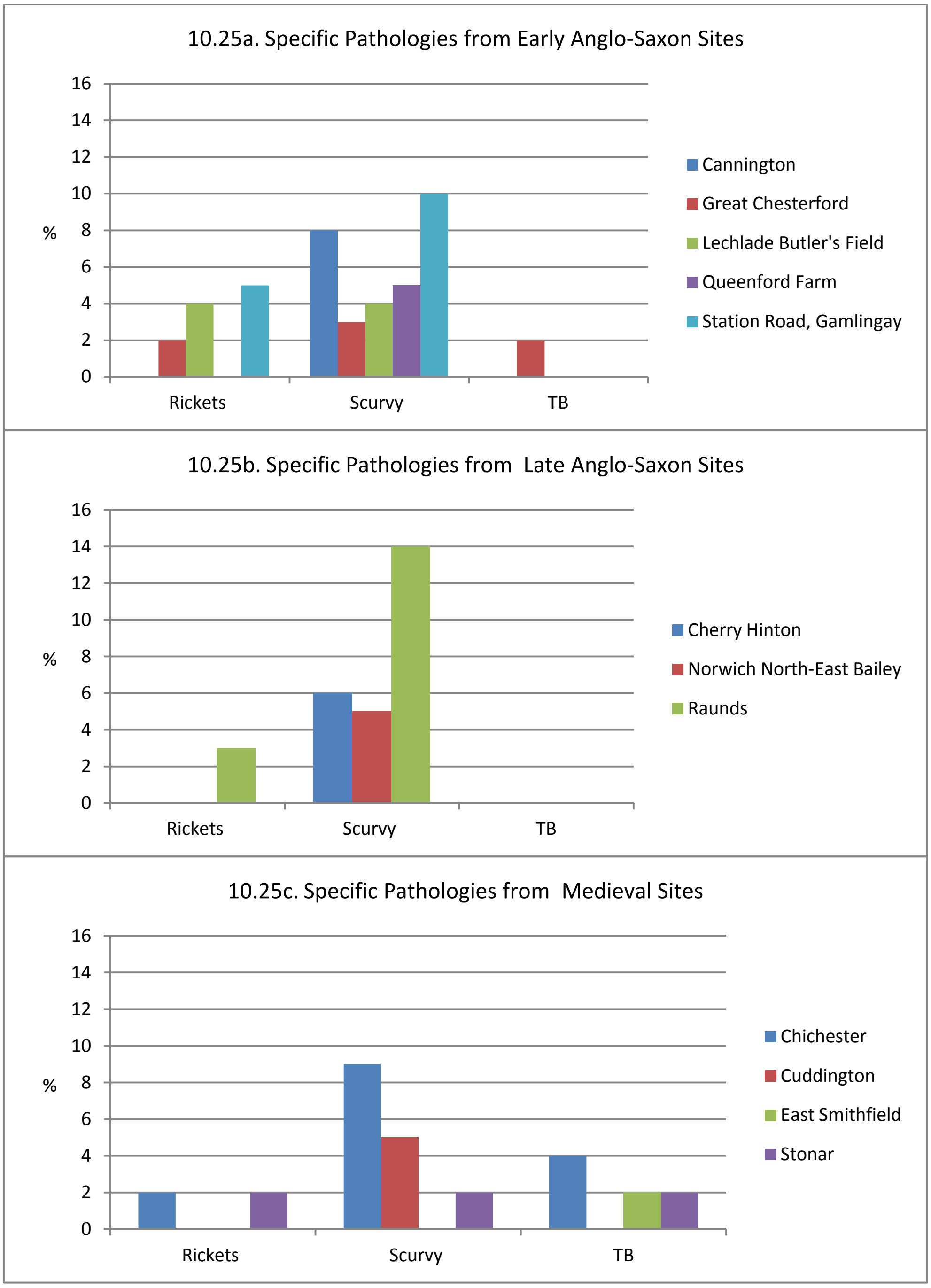


Figure 10.25: The distribution of the crude prevalence rate of specific pathologies on larger sites.

Summary of the Results

This chapter examined the mortality profiles of the Anglo-Saxon and medieval subadults and compared them with modern United Nations demographic statistics. To summarise, the Mortality Rate Ratio of the perinatal infants indicate excess female mortality for the majority of gestational categories for all three periods. This is also seen in the site analysis with five of the six sites examined displaying excess female mortality, with the exception of late Anglo-Saxon Cherry Hinton, indicating excess male mortality. The age distribution of all the individuals under six years showed a high concentration of mortality in the one-to-two year category for all periods, particularly apparent in the distribution of the sexed individuals. The analysis of MRR suggested that, if mortality was not within the expected range, there was a trend toward excess female mortality in the youngest age categories and excess male mortality in the older age groups, although the opposite is true for the early Anglo-Saxon sites of Great Chesterford and Queenford Farm. Two sites, both from the late Anglo-Saxon period, display very abnormal MRR - Cherry Hinton with very high levels of excess male mortality in five of the eight age categories, and Norwich North-East Bailey with high excess female mortality in all seven of the age categories represented.

The palaeopathological analysis indentified that although pathology was observed for all age categories (with the only exception being the early Anglo-Saxon 5-6 year category) there was little apparent trend to the age distribution of individuals displaying pathological changes. The late Anglo-Saxon period has the highest crude prevalence of both individuals displaying pathological changes and observed pathologies. Across all three periods cribra orbitalia is the most prevalent observed stress indicator displaying a trend towards the older age categories, followed by endocranial lesions with no apparent trend in age of individuals. Scurvy is the most prevalent disease recorded, observed in all age groups. High levels of observed pathology are recorded from early Anglo-Saxon Station Road Gamlingay (9/20), late Anglo-Saxon Raunds (67/99) and medieval Chichester (30/57) with crude prevalence rates above forty percent at 45%, 68% and 53% respectively. These three sites also have the highest prevalence of non-specific infection and specific pathologies for their respective periods. The high level of individuals displaying pathological changes may not necessarily be unexpected from a hospital site such as Chichester, yet are perhaps surprising from the rural sites of Raunds and Station Road Gamlingay. It is possible that the high levels of pathological responses recorded from these three sites indicate that these children were generally sicker than those from other sites in the study, suffering from high levels of stress and morbidity, perhaps due to nutritional deprivation. Conversely, if we consider the osteological paradox, these individuals could represent those with a strong immunological response to disease enduring chronic ailments most likely through the support of family. The significance of these osteoarchaeological and palaeopathological results will be considered further in Chapter 11, where the findings will be discussed in relation to the themes transpired from the background research and analysis of the documentary evidence that are presented in the earlier chapters of this thesis.

Chapter 11

Conclusions

Introduction

The purpose of this thesis was to conduct an osteoarchaeological analysis of Anglo-Saxon and medieval subadult mortality profiles to question the speculation made by some excavators that the under-representation of infants from burial populations could be due to the practice of infanticide in England during these periods. The following chapter discusses the results of this osteoarchaeological analysis in connection with the main themes presented by the review of the background literature and historical sources collated in the earlier chapters of this thesis. This examines the age and sex differentiated mortality and morbidity patterns of the early Anglo-Saxon, late Anglo-Saxon and medieval populations and discusses how these could have been affected by the social attitude towards illegitimacy, disability, infant feeding practices and gender preference. The final conclusions of this thesis are then presented, looking at whether it is possible to infer the practice of infanticide from the osteoarchaeological analysis of subadults from Anglo-Saxon and medieval burial populations.

Discussion

This study started with the recognition that infanticide of some form has been practiced at different social levels by many different societies worldwide. Nevertheless the practice comes under strict social controls with most societies permitting the riddance of a child only under specially defined circumstances (Dickemann 1975: 115).

Societies tend to mandate infanticide in areas affecting the entire society in either ecological (overpopulation) or social (illegitimacy) domains (Scrimshaw 1984: 448). When such mandates are not present or explicit, individuals may still choose overtly, covertly, or unconsciously to reduce their family size or influence spacing through behaviourally induced infant mortality (Scrimshaw 1983: 258). Family size regulation on this 'micro' level may be carried out independent of (and even in contradiction to) the cultural population policy, or it may be facilitated by culturally permitted behaviours (Scrimshaw 1984: 460). Infanticide can compromise a number of behaviours which are not necessarily mutually exclusive including; deliberate killing, placing the child in a dangerous situation, abandonment where the child might survive, 'accidents', excessive physical punishment, lowered biological support, lowered emotional support (Scrimshaw 1984: 444; 1983: 248).

The analysis of the age-at-death distribution of the perinatal infants indicated some similarities between the early Anglo-Saxon populations to the Romano-British samples studied by Mays (1993). With a strong peak around full term (38-40 weeks) the Romano-British and early Anglo-Saxon distributions differ from the expected perinatal mortality profile and are instead similar to the distribution of total modern live births; it is this pattern that led Mays (1993: 887) to the conclusion that infanticide was practiced in sufficient numbers to have had a dominant effect on the age distributions. It is interesting to note that it is the early Anglo-Saxon distribution that shows the most resemblance to the Romano-British populations studied by Mays (1993) as this is also the period that is closest chronologically. Some may argue that these comparable results are indicative of the continuation of cultural customs that caused abnormally high mortality in the immediate postnatal period. Any such argument could be supported by the similarities seen in the distributions of the late Anglo-Saxon and medieval sexed perinatal infants which are both significantly different from the distribution of total modern live births. However, the distributions of the late Anglo-Saxon and medieval sexed perinatal infants are also significantly different from the profiles for modern stillbirths and for modern live births dying within seven days of birth, suggesting that these archaeological samples are still not entirely representative of a natural mortality profile of infants dying within the immediate postnatal period. Even so, the differences between the early Anglo-Saxon perinatal age-at-death distribution compared to the late Anglo-Saxon and medieval mortality profiles could provide support for the argument that the introduction of Christianity during the Anglo-Saxon period affected the cultural customs regarding newborn infants. Perhaps it is possible to speculate that this is due to the efforts of the Christian Church preventing infanticide in the immediate postnatal period. Certainly the introduction of Christianity to England provides more documentary evidence discussing infanticide (both of direct murder and negligence, especially overlaying), particularly within the penitential context.

It is, however, extremely important to understand the context of those surviving documents. Firstly, the improvement of documentation over the course of the study period probably has much to do with the increasing visibility of infanticidal practices in the literature, perhaps more so than the actual diachronic variation of the practice. In particular, we have very few surviving documents from the early Anglo-Saxon period and so it should be expected that we would find less documentary evidence of infanticide from this early period in comparison to the late Anglo-Saxon and medieval periods. It is also important to realize that many of the documents discussed were of ecclesiastical nature and therefore it was the very purpose of the authors to be moralistic and perhaps even sensationalist in order to educate and shock the society into following their new fledgling religion. We should be aware that the Church was one of few institutions not only to have had the finances to produce these documents during the Anglo-Saxon and medieval period, but also to have had the capabilities to preserve these documents over the long period of time that has lapsed since their production. Therefore, the sources we have today may be very strongly biased towards the view of the Church in comparison to the prevailing views at the time.

Increasingly, historical documents are considered less as a source of reliable factual information about what happened in the early Middle Ages, tending more to be regarded as documents written within specific socio-political and religious contexts, often with an overtly commemorative and propagandist agenda (Williams 2006: 14). Certainly the penitential reiteration is not supported by criminal convictions for infanticide in Anglo-Saxon or medieval England, although this is also perhaps due to the lack of clarity in legislation or the inability to differentiate between deliberate infanticide and a natural or accidental death, during what was a period of high infant mortality and when judicial infrastructure was likely ineffectual. However, we see that with the introduction of specific legislation against infanticide from 1624 onwards, there is again an increase in the documentary evidence for the practice of infanticide within English society.

If we were to use the early Anglo-Saxon perinatal age-at-death assemblage to infer a practice of infanticide it would be necessary to also discuss possible motives, despite the complications presented by the limited documentation of this early period. From the few examples within the later Anglo-Saxon and medieval texts which mention deliberate killing of children, discussed in Chapter 2, we see that adultery and illegitimacy were cited among the motives (McLaughlin 1974: 157; Meens 1994: 57; Whitelock 1979: 816-822). This is reiterated by the 1624 statute which was specifically aimed at preventing the murder of bastard children (Goody 2000: 80; Scott 1999: 66; Williams 2001: 480). These observations are interesting because, as discussed in Chapter 2, illegitimacy is a commonly cited motive for infanticide in many societies (Daly & Wilson 1984: 493; Mull & Mull 1987: 119; Pinchbeck 1954: 310; Williamson 1978: 66). Illegitimacy, however, is dependent on the local definitions of marriage, which were shown to be relatively relaxed within the Anglo-Saxon and even medieval periods, as marriage was valid without banns or licence with no necessity for any religious ceremony or even a clergyman to be present (Given-Wilson & Curteis 1984: 27; Goody 1983: 147; Hanawalt 1986: 97; Kellum 1974: 377; Macfarlane 1993: 126; Stone 1977: 32; Ward 1992: 14; Wemple 1993: 234; Whitelock 1961: 152). Furthermore, the medieval church law considered all children to be legitimate if their parents were married, no matter when the marriage took place (Macfarlane 1980: 73). Whilst there is still evidence of ecclesiastical condemnation of unlawful conception (Attenborough 1922: 25-31; Clark 1994: 150; Jewell 1996: 66; Whitelock 1979: 396-397), there is little evidence of social stigma associated with illegitimacy in England before the sixteenth century.

It is believed by some (see Hoffer & Hull 1981) that the stigma of illegitimacy within England really began with the spate of ‘personal control’ laws that emerged towards the end of the sixteenth century. By forcing the parish to support destitute infants, the Elizabethan Poor Law of 1576 created strong resentment from the local community towards single mothers, and truly instigated that illegitimacy was a great dishonour and social disgrace (Hoffer & Hull 1981: 13). In order to prevent the need for parish support, the law placed pressure upon authorities to find and punish illegitimacy among the poor, whilst also increasing the incentive for the poor single women to perform infanticide, thus probably explaining the increase in the number of mothers indicted for the crime of bastard neonaticide after 1576 (Hoffer & Hull 1981: 17). Therefore, it is debatable whether the increased visibility of infanticide in indictment cases is due to the administrative nature of the statutes and subsequent convictions. Alternatively, the introduction of the 1576 Poor Law and the 1624 statute, both of which strengthened the association between illegitimacy and guilt (Damme 1978: 12; Jackson 1996: 36), actually caused an increase in infanticide by making the stigma of illegitimacy appear to the desperate (usually young) woman a worse crime (in social or psychological terms at least) than secretly killing one's own infant.

Physical and mental deformities are another common reason identified in Chapter 2 for infanticide practiced within the first few days of life in many human societies (Chagnon *et al.* 1979: 304; Neel 1970: 816). Although none of the Anglo-Saxon and medieval children within this study showed any obvious indication of a congenital condition that could have presented the individual with incapacitating symptoms, this does not necessarily suggest that disabled children were immediately killed or excluded from the studied cemeteries. It is likely to reflect the difficulties of determining the presence of such abnormalities from poorly preserved and fragmentary subadult remains. This is especially true given that many congenital conditions become more apparent to osteoarchaeological investigation through the observation of abnormal fusion and growth, and also with the development of abnormal musculoskeletal stress markers which require time to develop (Buikstra &

Ubelaker 1994: 116; Roberts & Manchester 2005: 62). Skeletal evidence from other Anglo-Saxon and medieval cemeteries, as well as older individuals from some of the studied sites, provides examples of individuals with chronic debilitating diseases (congenital or otherwise) that would suggest parents would choose to take on long-term care of their sick children rather than abandon or kill them.

The documentary sources discussed in Chapter 4 indicate that, despite the condemnation from theologians and preachers against exaggerated mourning, parents displayed violent grief or remorse when a child was sick, injured or dying (Colgrave 1927: 38-41; Downer 1972: 273; Finucane 1977: 109; Gordon 1986: 517; Nelson 1994: 91; Shahar 1990: 148). This suggests that Anglo-Saxon and medieval parents held compassion for their young, rather than the often discussed theory that they were emotionally distant from their children (Gordon 1986: 520; Hill & Tidsall 1997: 14; Hoyles 1979: 21; McMahan 2002: 342; Pollock 1993: 263; Scheper-Hughes 1987: 2; Scott 1999: 65; 1992: 87; Tucker 1977: 19). The skeletal data, however, cannot convey sentiments. Many parents of disabled children describe the experience of raising such children as distressing; firstly in the inability to make their children 'better' or 'normal' (leaving some parents with a feeling of guilt), also in the struggles of daily life and providing for the additional needs of their child, and finally in dealing with possible prejudices directed at the child (Sanders & Morgan 1997: 16; Veisson 1999: 87). Whilst we have some possible examples of individuals displaying pathological conditions that may have required long term care for the survival of the individual (Boddington 1996: 41; Hawkes & Wells 1983: 9; Powell 1996: 120; Wileman 2005: 138), these are still very much a minority within the archaeological populations. They may instead reflect the difficult choice made by a few parents to care for their sick children, rather than the normal practice within society.

An additional motive for infanticide discussed in Chapter 2 is family size regulation to reduce demands on family resources. The documentary sources for Anglo-Saxon England discussed in Chapter 6 indicate that the focus of the Anglo-Saxon family was the nuclear grouping of parents and children (Arnold 1988: 177; Crawford 1999: 10; Drewett *et al.* 1988: 273; Yanagisako 1979: 178). The two main surveys that enumerate medieval household occupants, the Domesday Book and the late-fourteenth-century poll taxes, also indicate that simple families were the rule, with manorial records showing households that rarely comprised of more than two generations (Hanawalt 1986: 92; McLaren 1990: 107). Generally speaking, poorer households were smaller through a combination of lower fertility and higher mortality than their wealthier counterparts (Dyer 1989: 158; Hanawalt 1986: 95; Shahar 1990: 121).

Parental investment in children has much to do with whether or not a child is considered an economic and social advantage, or rather a hindrance (Voland 1998: 362). Caldwell's (Caldwell 2005; 1980; 1976) theory of Intergenerational Wealth Flows posits that in traditional societies children are a net economic benefit to their parents and so fertility is high, whereas in modern societies children are a net cost and subsequently fertility is low (Hirschman 1994: 214; Johnson-Hanks 2008: 306). The impact of family structure on fertility was also discussed by Kingsley Davis (1955) who noted that extended family households were associated with higher fertility, attributed to the extensive supports of the extended family structure for early marriage and the burden of child care being subsidized by other members of the household (Hirschman 1994: 219). This is in contrast to the nuclear family system (Hirschman 1994: 219) that developed in England from around the seventh century, which encouraged the belief that children are considered 'costly' because it prevents spreading of costs of raising children through kinship (Macfarlane 1993: 68; Yanagisako 1979: 178). This was further emphasised by the early monetized economy in England caused each additional child to be seen as a monetary expense (Macfarlane 1993: 68). Furthermore, the peculiar English tradition of sending young children away from home in order to earn their separate keep, which started with fostering in the Anglo-Saxon period but increased dramatically with the proletarianization of the smaller peasants at the end of the medieval period, saw that children did not automatically invest their wealth back into a family fund from which they automatically inherited (Macfarlane 1993: 334).

Sex-preferential infanticide of females is probably the most common form of infanticide in the world today and it is this form of the practice that would be most likely, if abnormal mortality figures are observed between the sexes. It is well known from the osteoarchaeological literature that the probability of dying is not constant with age. However, this study has also illustrated the importance of the predictable variation in mortality between the sexes that is implicated by higher conception rate yet greater biological vulnerability of males (Ciocca 1940a: 192; Coale 1991: 519; Fuse & Crenshaw 2006: 364; Waldron 1998b: 70). This is particularly relevant for cultural studies such as this, where atypical male to female mortality ratios can indicate gender-specific mortality through possible deliberate discrimination.

Therefore, although the indication of a diachronic change in age-at-death distributions of the perinatal individuals is intriguing, any inferences suggesting that this evidence of the practice of infanticide needs to be explored further. The MRR results of the perinatal individuals indicate that females are over represented in all three periods. This suggests that the diachronic differences in the age-at-death mortality profiles of perinatal infants in the pagan early Anglo-Saxon period compared to the Christian late Anglo-Saxon and medieval periods is not caused by a change in the treatment of the sexes. However, this does not prevent the suggestion that perinatal females were undervalued, neglected or even deliberately killed in all three periods. This may provide some explanation as to why the perinatal age-at-death distribution for all three periods were significantly different from the expected mortality profiles of modern still births and deaths within seven days of birth. Some historians have speculated that the higher male to female sex ratios reported in some medieval documents were caused by the practice of preferential female infanticide due to the low value and low status of women as well as the custom of dowry (Boswell 1989: 409; Coleman 1976: 55; 1971: 208; Damme 1978: 2; Kellum 1974: 368; Nelson 1994: 92; vom Saal 1994: 59).

Whilst the results from the perinatal individuals are certainly interesting, it would be restrictive to only study the youngest individuals from these periods as this would exclude any examination of passive infanticide which is particularly relevant in the discussion of preferential female infanticide. Passive infanticide occurs through underinvestment which is defined in relative terms because such neglect occurs only when an infant or child receives less than the family might be able to provide and less than family members know should be provided (Scrimshaw 1983: 248). The evidence of differential care or passive infanticide is difficult to come by but the best evidence emerges from the examination of sex differentials in mortality and morbidity (Scrimshaw 1984: 450; 1983: 249).

The age-at-death distribution of the individuals under the age of six years showed a high concentration of mortality in the 1-2 year category for all periods, which is particularly apparent in the distributions of the sexed individuals. This is abnormal because, as it was identified in Chapter 3, we would normally expect the neonate group to show the highest mortality because neonatal deaths contribute to about 40% of all mortality in children under the age of five globally (Hall 2005: 4; Wiley & Pike 1998: 318). The high mortality in the 1-2 year age category could be suggestive of cultural mechanisms in this age group that raised the risk of mortality. One possible explanation is that this age group coincides with the weaning period which is considered to be the moment of the highest metabolic stress in early childhood. The review of the historical sources in Chapter 6 suggested a variability of commencement of weaning between one and three years with a quick weaning process being indicated by some sources and, possibly, a shorter nursing period for girls and for the children of peasants (Crawford 1999: 73; McLaughlin 1974: 116; Shahar 1990: 79). This hypothesis would be supported by some of the stable isotope research such as the North Lincolnshire Anglo-Saxon sites studied by Macpherson (2006) which showed that the children were unlikely to be fully weaned until sometime before their second birthday. Further evidence comes from the investigation by Mays (2003a) on material from tenth- to sixteenth-century Wharram Percy which suggested a cessation of breastfeeding between one and two years. Conversely, the stable isotope analysis from the early Anglo-Saxon cemetery of Queenford Farm, Dorchester-on-Thames, Oxfordshire, indicate a gradual weaning process starting at one-and-a-half years, with the majority of children seeming to have been fully weaned between three and four years (Fuller *et al.* 2006b: 48). This gradual weaning may help explain the higher mortality seen in the 2-3 and 3-4 year age categories observed for this site in this present study. This is because, although a slow weaning process is usually advised, late weaning can potentially cause calorie insufficiency and vitamin deficiency (Katzenberg *et al.* 1996: 180). However, it is also possible that the long continuation of breast feeding was at least partially due to a lack of appropriate weaning foods. The palaeopathological analysis in Chapter 10 of this present study showed examples of ectocranial lesions and cribra orbitalia and revealed a high incidence of endocranial lesions at Queenford Farm, the highest for the period. There is also evidence of scurvy which could suggest a low proportion of fruit and vegetables in the diet. The palaeopathological data therefore suggests that the children from Queenford Farm endured hardship within their short lives, perhaps through inadequate diet, although it is debatable whether this is an affect of prolonged nursing or whether the period of nursing was extended because of the poor availability of resources.

In the analysis of the MRR of individuals under six-years-old, however, we see a less clear picture regarding sex differentiated mortality. Whilst both the late Anglo-Saxon and medieval periods show excess female mortality in the foetus category, the mortality of these pre-term individuals are unlikely to indicate sex-preferential infanticide instead being affected by the endogenous state of the infant as the result of genetic and maternal influences (e.g. congenital anomalies, prematurity, low birth weight). Although the excess female mortality recorded for the neonatal and infant age groups of the early Anglo-Saxon and medieval periods could perhaps provide an argument towards the practice of preferential female infanticide, the opposite could be said of the late Anglo-Saxon period where excess male mortality is observed. Furthermore, whilst there was a slight trend toward excess female mortality in the youngest age categories, in the older age groups we observed more examples of excess male mortality. The palaeopathological investigation in Chapter 10 also showed higher numbers of males with pathological changes to females in all three periods. However, from the discussion in Chapter 3, we can see that this is the pattern that we would normally expect because of the biological disadvantage of males that causes them to be more susceptible to illnesses (Christensen *et al.* 2001: 179; Rasmuson 1971: 45; Washburn *et al.* 1965: 57). Therefore, neither the MRR nor the pathological investigation of the individuals under six years old provide any support to a hypothesis of passive infanticide directed only towards females.

In the few infanticide indictments where the sex of the deceased is provided there is little difference between the recorded sexes (Helmholtz 1975: 385). In the sample examined by Hoffer and Hull (1981: 114) there was a slightly higher proportion of male victims. Similarly, if infanticides were being concealed by accidental deaths, then one might expect a higher proportion of female infants to appear among the cases, but the ratio between the sexes is quite close, with males suffering more accidents (Hanawalt 1998: 168; 1986: 102). Two studies by Gordon (1991; 1986) on the miracles in the *Lives of the Saints* observed greater proportions of boys to girls receiving aid, the greater number of boys in this series is not surprising as within modern clinical figures we see that boys consistently suffer more accidents than girls (Kraemer 2000: 1610). The higher rates of accidents commonly observed for boys, due to their tendency for more adventurous or rougher play (Jones 1999: 569), may help explain the excess male mortality observed in the 4-5 year age category for the early and late Anglo-Saxon periods rather than cultural practices working against males just at this age.

The study of the historical documents in Chapter 6 did not provide evidence to support a motive for the practice of preferential female infanticide in Anglo-Saxon and medieval England as there is little to suggest that women during these periods were particularly undervalued. The Anglo-Saxon sources indicate that women were protected by the legal framework, being both guarded by and accountable to their family even after marriage (Attenborough 1922: 5-17; Brentano 1966: 150; Clunies Ross 1985: 7; Crawford 1999: 175; Fell *et al.* 1984: 62; Herlihy 1985: 100; Page 1970: 66; Ward 1992: 26; Wemple 1993: 229; Whitelock 1979: 391-394; 1961: 45). Whilst some could try to argue that such protection is veiled dominance of the women, one that they could only escape through entry into a nunnery, this would ignore the responsibility of women for the safeguarding of the storeroom (Crawford 2001: 486; Fell *et al.* 1984: 60; Herlihy 1985: 52; Page 1970: 72), or the fact that Saxon monasteries provided a social sphere in which the aristocratic woman could gain respected authority (Goody 1983: 66; Keeping 2000: 82; McLaren 1990: 104). The lack of a dowry (Goody 1983: 254) and the apparently egalitarian inheritance system (McNamara & Wemple 1988: 90; Whitelock 1979: 534-537) revealed in Anglo-Saxon sources, argues against an economic motive for preferential female infanticide as a daughter's marriage does not result in large amounts of assets moving out of the family. Rather we have the pattern of indirect dowry which could symbolize the requirement for the groom to show his ability to provide for his wife (Goody 1983: 254; McNamara & Wemple 1988: 87; Page 1970: 73).

The growth of bureaucracy in the medieval period limited the importance of women as administrators, and although they were still important in artisan industry, the rise of male-dominated guilds also reduced their economic potential outside of the family business and some devaluation of medieval women (Herlihy 1985: 101). The introduction of the dowry during the medieval period may have both been as a consequence of, and also resulting in, coerced marriages (Anderson 2007: 170). Yet the dowries recorded in the medieval English texts are not at the devastatingly high amounts reported elsewhere in Europe (Macfarlane 1993: 271). Hanawalt (1986: 102) also noted that medieval English sources do not contain the usual peasant complaints over the liabilities of excess female children. Furthermore, the rising age of marriage and increase of waged labour meant that English dowries were savings amassed by the bride over a number of years, not just an outlay by her family (Macfarlane 1993: 268). Whilst we see the gradual establishment of primogeniture in the medieval period, daughters were not necessarily completely overlooked as they continued to inherit, although usually only in the absence of male heirs (Bennett 1987: 69; Ward 1992: 2).

Therefore, even with the rise of the dowry in medieval England, it does not appear to be at such a high level to suggest that women were viewed as a significant economic detriment to cause despair, for whilst there may have been some feeling in the English past that girls were marginally more of a cost, it is likely that their slightly lower value was compensated for by fewer costs, particularly in education and apprenticeship (Macfarlane 1993: 69). Certainly in the middling groups during the later medieval period the education and setting up of a son was usually more expensive than that of a daughter (Macfarlane 1993: 69). Thus we do not find a convincing argument for preferential female infanticide.

Conclusion

The high proportion of perinatal deaths recorded at full term in the early Anglo-Saxon period may suggest that infanticide was practiced at a high enough level to effect the mortality distribution. This may be a continuation of practices performed during the Romano-British period and may reflect pagan ideologies that are not perpetuated into the Christian period as the late Anglo-Saxon and medieval perinatal age-at death distributions are more suggestive of a normative mortality profile. One suggestion that should be considered for the high proportion of perinatal deaths recorded at full term in the early Anglo-Saxon period is the continuation of a practice such as that described by Soranus where *'After omphalotomy, the majority of the barbarians, as the Germans and Scythians, and even some of the Hellenes, put the newborn into cold water in order to make it firm and to let die, as not worth rearing, one that cannot bear the chilling but becomes livid or convulsed'* (Temkin 1956: 82). Any such ritual would have been detrimental to the life of the newborn, and it is likely weaker individuals would have perished prematurely if such practices were also being performed.

Discussion of possible motives for infanticide during the Anglo-Saxon period suggest that illegitimacy is an unlikely cause, as there appears to be little stigma attached to bastard children. This is particularly true of the pagan Anglo-Saxon period where we have evidence for open concubinage, at least within the upper ranks of society. Whilst infanticide of disabled individuals is also a possibility, given the typical low rates of abnormal birth this is unlikely to have been at a level to affect the mortality profile (Meindl & Russell 1998: 377). Furthermore, both the documentary evidence and possible skeletal examples of disabled individuals within the archaeological record

(Boddington 1996: 41; Gordon 1986: 518; Hanawalt 1986: 103; Hawkes & Wells 1983: 9; Powell 1996: 120) would suggest that at least some parents or maybe the society were willing and able to provide the additional care required to enable a disabled child to survive even to adulthood.

The excess female mortality indicated by the Mortality Rate Ratio results for the perinatal individuals for all three periods and for the neonatal and infant age groups of the early Anglo-Saxon and medieval periods could perhaps provide an argument towards the practice of preferential female infanticide. However, the opposite could be said of the late Anglo-Saxon period, where excess male mortality was observed. The excess male mortality shown in older age categories certainly prevents the suggestion of female neglect, so called passive infanticide. Whilst there is little surviving documentary evidence from the early Anglo-Saxon period (Campbell 1986: 131; Crawford 1999: 41; Whitelock 1979: 361), the review of the later documentary evidence does not provide any strong indication of the devaluation of women in either the Anglo-Saxon or medieval periods. As family administrators, Anglo-Saxon women were provided positions of responsibility, they could inherit property and dispose of it how they pleased. Significantly, the system of direct dowry did not develop until the medieval period however, and even then the dowries did not appear to be as financially crippling as some authors have presumed using deductions from European sources (Boswell 1989: 409; Damme 1978: 2; Kellum 1974: 368).

This present study has indicated that there is a large variation in the mortality distributions and MRR from different sites within the same period. As we are discussing archaeological remains, it is important to recall Chapter 7 which examined the many factors that conspire to render osteological samples incomplete and under-representative of the population. We must acknowledge the potential bias that could be caused by studying the MRR which only takes into consideration those individuals that could be both aged to a relatively narrow age category and also to have remaining the sexually diagnostic skeletal elements; any unsexed or indeterminate individuals are not included in the MRR calculation. Differential bone preservation and site disturbance also have the potential to negatively bias the archaeological samples, as does incomplete excavation which can be particularly detrimental if some form of social (age or sex) segregation was employed in the burial practice. It is often suggested that the increase in recovery of subadults from Christian cemeteries as opposed to the pagan burial grounds in the Anglo-Saxon period is a result of change in burial practice with the social grouping within the churchyard being favourable to archaeological recovery (Ayres 1985: 58; Lucy 1994: 27).

A possibility for the low representation of children recovered is that infants and young children were disposed of outside the community cemetery, possibly because they were not considered full members of society. However, while there are few enough Anglo-Saxon infants recovered from cemeteries, the practice of burying infants in and around settlements does not appear to have been frequently adopted by the Anglo-Saxons. Cremation was a viable alternative in the pre-Christian Anglo-Saxon period, nevertheless, there is little suggestion from the cremated material so far studied by osteoarchaeologists that this was a preferred method of disposal of subadults, though admittedly cremation studies have been neglected by many biological anthropologists. There are, however, some researchers such as McKinley (2006; 2005; 1994a; b; 1989) who are devoting much effort to prevent the continuation of this effect.

In medieval Christian belief, newborns were considered to be corrupted by the Original Sin of their conception, and unbaptised or stillborn infants were not permitted burial in consecrated ground which occurred from the tenth century onwards (Buckberry 2008: 149; Cherryson 2008: 122; Gittos 2002: 201; Holloway 2008: 131). Whilst it is often reported within the archaeological literature that the low recovery of infants from Christian Anglo-Saxon and medieval cemeteries is due to the exclusion of unbaptised infants from consecrated ground (Daniell 1997: 127; Finucane 1981: 54; Gilchrist & Sloane 2005: 72; Kellum 1974: 374; Rahtz 1969: 88), any such interpretation would be dependent on a baptismal ritual being unavailable for very young or very sick infants. However, Chapter 3 of this study indicated that even if a priest could not provide a baptism to a dying newborn infant, a male member of kin or even the midwife could perform an emergency baptism (Hanawalt 1986: 172; Shahar 1990: 49), and so there should have been very few children who were not baptised (Daniell 1997: 128). Furthermore, excavations have only occasionally revealed infant burials within medieval settlements, and so this appears to be an extremely rare practice. Importantly, this investigation has shown that infants and children of all ages are recovered from cemeteries in all three periods. There is, therefore, no conclusive link between age and burial in the community cemetery. It is pertinent that the more recent excavations appear to be recovering a higher percentage of subadults, and may indicate that younger individuals were indeed given a lower priority during earlier excavations.

A further aspect regarding the low recovery of subadults is the presumption that mortality rates were high at a time when we have no records to prove it is so. Mortality figures are often estimated using models based on the post-medieval period.

This may not always be appropriate, because the morbidity, and thus mortality, reactions of a population are greatly affected by many factors including nutrition, living environment, working conditions, and sanitation; all of which are known to have deteriorated with the rise of urbanization and industrialization. It is possible that the mortality rates within Anglo-Saxon and medieval England were actually lower than has been previously supposed by osteoarchaeologists and palaeodemographers. If this is coupled with low fertility, which may possibly be inferred from late marriage practices, the use of contraceptive methods including *coitus interruptus*, a long lactation period, and possibly inadequate diet causing famine amenorrhoea, the birth rate, and thus the death rate, could be much lower than previously thought.

In conclusion, this study identified an abnormal age-at-death distribution for the early Anglo-Saxon perinatal individuals and excess female mortality was observed for the perinatal individuals from all three periods and for the neonatal and infant individuals from the early Anglo-Saxon and medieval period. These are unusual mortality distributions. Whilst it is true that these distributions are likely to be biased by recovery and representation issues affecting osteoarchaeological studies, these biases are present within any osteoarchaeological study and their affect on mortality profiles remains unquantifiable. Any interpretations taken from osteoarchaeological data are, therefore, made on the assumption that studied individuals are representative of the buried population. This study has shown that there were mid-late Anglo-Saxon and medieval laws and warnings against the killing of children and, like most societies, there would certainly have been some examples of infanticide within the Anglo-Saxon and medieval communities. In some cases this may be a deliberate action either in response to a child's disablement or due to a lack of resources, or an act of insanity, for there will always be some who cannot cope with the trials of parenthood, and unfortunately there are always some who will act purely in malice. Nevertheless, the ecclesiastic and secular warnings are advisory and would suggest against an acceptance of the wide-scale practice of infanticide, at least within late Anglo-Saxon or medieval periods. There is certainly no documentary support for a hypothesis of preferential female infanticide for the late Anglo-Saxon or medieval periods.

We do not, however, have sufficient documentary sources for the early Anglo-Saxon period. We should, therefore, perhaps consider only the osteoarchaeological evidence for this period. The perinatal mortality distribution of the early Anglo-Saxon population was particularly abnormal; being significantly different from the expected perinatal mortality profile and instead showing similarities to the distribution of modern live births. The Mortality Rate Ratio results for the early Anglo-Saxon period were also abnormal indicating excess female mortality for the neonatal and infant categories and for all but one of the perinatal age categories. In summary, the osteoarchaeological results for the early Anglo-Saxon period do not reflect normal mortality patterns. Instead the results suggest that cultural practices may have occurred during the early Anglo-Saxon period that increased the likelihood of female mortality, certainly during the immediate post-partum period but also, possibly, during the first year of life. These cultural practices could have included (among others) sex differentiated feeding patterns, sleeping arrangements, parental attentiveness or even the deliberate infanticide of females. The excess male mortality observed for the 3-4, 4-5 and 5-6 year age categories, however, indicates that any cultural practices that had been performed to the detriment of girls during the early Anglo-Saxon period were discontinued after the first year.

Suggestions for Further Work

The assessment and recording of the sex of subadults should be incorporated into the routine methods employed by the osteoarchaeologist. The published techniques are easily repeatable and the results of tests by several authors have reported reliability levels akin to many other methods commonly used in biological anthropology. It is time for the field to forget the assumption that it is not possible to determine the sex of subadults. However, this does not preclude the investigation into new methodologies and techniques of sex assessment of subadults, rather more current research could help overcome some of the adversities felt against the subject. In relation to this, it would be particularly interesting to include the sex assessment of subadults in stable isotope studies to allow for an investigation into sex dependant variation on weaning practices.

A thorough archaeological investigation of all examples of subadults buried in British Anglo-Saxon and medieval settlements, and other non-cemetery contexts would add to the discussion on representation of subadults from these periods, as could further research on the proportion of subadult remains recovered from Anglo-Saxon cremation burials. To answer questions regarding the importance of subadults in past excavation strategies, and the affect this has had on subadult representation, it would be very interesting to see a study devoted to the comparison of excavation date to the representation of subadults – particularly one that also compared the results for different age periods (including Roman and post-medieval).

Whilst we are beginning to have some institutions creating databases of their holding collections it would be of extreme benefit to osteoarchaeological researchers working on English sites to have a catalogue of all available skeletal collections and their holding institutions in the country. If such a database could also be expanded to contain demographic information of the archaeological populations it would become an invaluable tool. It would not only save the time and expense of unnecessary communication to incorrect institutions but could also encourage new research through allowing the easier identification of under-studied sites, subjects or areas.

Bibliography

Adair, R. 1996. *Courtship, Illegitimacy and Marriage in Early Modern England*. Manchester: Manchester University Press.

Adão Perini, T., G. L. d. Oliveira, J. d. S. Ornellas & F. P. d. Oliveira 2005. Technical Error of Measurement in Anthropometry. *Revista Brasileira de Medicina do Esporte* 11(1): 86-90.

Adkins, L. & R. A. Adkins 1994. *Handbook to Life in Ancient Rome*. New York: Facts on File.

Aiken, H. D. 1973. Life and the Right to Life. In D. C. B. Hilton, M. Harris, P. Condliffe & B. Berkley (ed.) *Ethical Issues in Human Genetics: Genetic Counselling and the Use of Genetic Knowledge*: 173-183. London: Plenum Press.

Aldsworth, F. & M. Welch 1978. Droxford Anglo-Saxon Cemetery, Soberton, Hampshire. *Proceedings of the Hampshire Field Club and Archaeological Society* 35: 93-182.

Alexander, R. D. 1974. The Evolution of Social Behaviour. *Annual Review of Ecology and Systematics* 5: 325-383.

Alexandre-Bidon, D. & D. Lett 1999. *Children in the Middle Ages: fifth to fifteenth Centuries*. Notre Dame, Indiana: The University of Notre Dame Press.

Allason-Jones, L. 2004. The Family in Roman Britain. In M. Todd (ed.) *A Companion to Roman Britain*: 273-287. Oxford: Blackwell Publishing.

Andersen, J. G. & K. Manchester 1992. The Rhinomaxillary Syndrome in Leprosy: a Clinical, Radiological and Palaeopathological Study. *International Journal of Osteoarchaeology* 2: 121-129.

Andersen, J. G. & K. Manchester 1987. Grooving of the Proximal Phalanx in Leprosy: A Palaeopathological and Radiological Study. *Journal of Archaeological Science* 14: 77-82.

Andersen, J. G., K. Manchester & C. Roberts 1994. Septic Bone Changes in Leprosy: a Clinical, Radiological and Palaeopathological Review. *International Journal of Osteoarchaeology* 4: 21-30.

Anderson, D. L., G.W. Thompson & F. Popvich 1976. Age Attainment of Mineralization Stages of the Permanent Dentition. *Journal of Forensic Sciences* 21: 191-200.

Anderson, S. 2007. The Economics of Dowry and Brideprice. *The Journal of Economic Perspectives* 21(4): 151-174.

Anderson, T. & J. Andrews 2001. The Human Remains. In M. Hicks and A. Hicks (eds) *St Gregory's Priory, Northgate, Canterbury Excavations 1988-91*: 338-370. Canterbury: Canterbury Archaeological Trust Ltd.

Andrews, P. (ed.) 1997. *Excavations at Hamwic Volume 2: Excavations at Six Dials*. CBA Research Report 109

Angel, J. L. 1969. The Bases of Palaeodemography. *American Journal of Physical Anthropology* 30: 427-438.

Ariès, P. 1962. *Centuries of Childhood*. London: Cape.

Arnold, C. 1980. Wealth and Social Structure: A Matter of Life and Death. In P. Rahtz, T. M. Dickinson and L. Watts (eds) *Anglo-Saxon Cemeteries 1979: The Fourth Anglo-Saxon Symposium at Oxford*: 81-142. Oxford: B.A.R. British Series.

Arnold, C. J. 1988. *An Archaeology of the Early Anglo-Saxon Kingdoms*. London: Routledge.

Arnold, F. & E. C. Y. Kuo 1984. The Value of Daughters and Sons: A Comparative Study of the Gender Preferences of Parents. *Journal of Comparative Family Studies* 15(2): 299-318.

Arnon, S. S., T.F. Midura, K. Damus, B. Thompson, R.M. Wood, J. Chin 1979. Honey and Other Environmental Risk Factors for Infant Botulism. *Journal of Pediatrics* 94: 331–336.

Atkins, P. J. 1992. White Poison? The Social Consequences of Milk Consumption, 1850-1930. *Social History of Medicine* 5(2): 207-227.

Attenborough, F. L. 1922. *The Laws of the Earliest Kings*. Felinfach: Llanerch Publishers. A Facsimile Reprint of the 1922 Cambridge University Press Edition

Aufderheide, A. C. & C. Rodriguez-Martin 1998. *The Cambridge Encyclopedia of Human Palaeopathology*. Cambridge: Cambridge University Press.
Austin, M. W. 2007. *Conceptions of Parenthood: Ethics and the Family*. Ashgate Publishing Ltd.
Avery, J. K. 1987. *Oral Development and Histology*. London: Williams & Wilkins.
Aykroyd, R. G., D. Lucy, A. M. Pollard & T. Solheim 1997. Technical Note: Regression Analysis in Adult Age Estimation. *American Journal of Physical Anthropology* 104: 259–265.
Ayres, B. 1990. Norwich. *Current Archaeology* 122: 56-59.
Ayres, B. 1985. *Excavations within the North-East Bailey of Norwich Castle, 1979*. Norfolk Archaeological Unit, Norfolk Museums Service: East Anglian Archaeology 28.
Bakwin, H. 1928. The Sex Factor in Human Mortality. *Human Biology* 1(1): 90-116.
Balikci, A. 1967. Female Infanticide on the Arctic Coast. *Man* 2: 615-625.
Barber, B., S. Chew & W. White 2004. *The Cistercian Abbey of St Mary Stratford Langthorne, Essex: Archaeological Excavations for the London Underground Limited Jubilee Line Extension Project*. MoLAS Monograph 18
Barber, P. 1988. *Vampires, Burial and Death: Folklore and Reality*. London: Yale University Press.
Barclay, A. & C. Halpin 1998. *Excavations at Barrow Hills, Radley, Oxfordshire. Volume 1: The Neolithic and Bronze Age Monument Complex*. Thames Valley Landscapes Vol. 12. Oxford: Oxford Archaeological Unit.
Barley, N. 1995. *Dancing on the Grave: Encounters with Death*. London: John Murray Publishers Ltd.
Baron, F. X. 1979. Children and Violence in Chaucer's Canterbury Tales. *Journal of Psychohistory* 7(1): 77-104.
Bass, W. M. 1999. *Human Osteology: A Laboratory and Field Manual* (4th edn). Columbia, Missouri: Missouri Archaeological Society.
Bates, C. J. & H. Tsuchiya 1990. Zinc in Breast Milk During Prolonged Lactation: Comparison Between the UK and the Gambia. *European Journal of Clinical Nutrition* 44(1): 61-69.
Baxter, J. E. 2008. The Archaeology of Childhood. *Annual Review of Anthropology* 37: 159–175.
Baxter, J. E. 2005. *The Archaeology of Childhood: Children, Gender and Material Culture*. Oxford: Altamira Press.
Bayley, J. 1980. The Skeletal Remains. In R. Shoesmith (ed.) *Hereford City Excavations 1: Excavations at Castle Green*. Council for British Archaeology Research Report 36.
Beattie, J. M. 1974. The Pattern of Crime in England 1660-1800. *Past & Present* 62: 47-95.
Becker, M. J. 1995. Infanticide, Child Sacrifice and Infant Mortality Rates: Direct Archaeological Evidence as Interpreted by Human Skeletal Analysis. *Old World Archaeology Newsletter* XVIII(2): 24-31.
Bekvalac, J. & L. Cowal 2007. http://www.museumoflondon.org.uk/English/Collections/OnlineResources/CHB/Database/Medieval+cemeteries/St+Benet+Sherehog.htm *accessed 28/05/08*.
Bekvalac, J., L. Cowal, T. Kausmally & R. Mikulski 2007a. http://www.museumoflondon.org.uk/English/Collections/OnlineResources/CHB/Database/Medieval+cemeteries/StMaryGraces.htm. *accessed 28/05/08*.
Bekvalac, J., L. Cowal, R. Mikulski & T. Kausmally 2007b. http://www.museumoflondon.org.uk/English/Collections/OnlineResources/CHB/Database/Medieval+cemeteries/ESmithfieldBlackDeath.htm. *accessed 28/05/08*.
Bekvalac, J., L.Cowal, T. Kausmally & R. Mikulski 2008. http://www.museumoflondon.org.uk/English/Collections/OnlineResources/CHB/Database/Medieval+cemeteries/spitalsquare.htm *accessed 28/05/08*.
Bell, D. 1997. Defining Marriage and Legitimacy. *Current Anthropology* 38(2): 237-254.
Bell, L. S., M. F. Skinner & S. J. Jones 1996. The Speed of Post Mortem Change to the Human Skeleton and its Taphonomic Significance. *Forensic Science International* 82: 129-140.

Bello, S. & P. Andrews 2006. The Intrinsic Pattern of Preservation of Human Skeletons and its Influence on the Interpretation of Funerary Behaviours. In R. Gowland and C. Knüsel (eds) *Social Archaeology of Funerary Remains*: 1-13. Oxford: Oxbow.

Benn, S. I. 1973. Abortion, Infanticide, and Respect for Persons. In J. Feinberg (ed.) *The Problem of Abortion*: 92-104. Belmont: Wadsworth.

Bennett, H. 1923. The Exposure of Infants in Ancient Rome. *Classical Journal* 18: 341-45.

Bennett, J. M. 1987. *Women in the Medieval English Countryside: Gender and Household in Brigstock before the Plague*. Oxford: Oxford University Press.

Bennike, P., M. E. Lewis, H. Schutkowski & F. Valentin 2005. Comparison of Child Morbidity in Two Contrasting Medieval Cemeteries From Denmark. *American Journal of Physical Anthropology* 128: 734-746.

Benton, J. F. 1985. Trotula, Women's Problems, and the Professionalization of Medicine in the Middle Ages. *Bulletin of the History of Medicine* 39: 30-53.

Bethell, P. H. & M. O. H. Carver 1987. Detection and Enhancement of Decayed Inhumations at Sutton Hoo. In A. Boddington, A. N. Garland and R. C. Janaway (eds) *Death, Decay and Reconstruction*: 10-21. Manchester: Manchester University Press.

Biddle, M. 2005. *Nonsuch Palace: The Material Culture of a Noble Household*. Oxford: Oxbow Books.

Biddle, M. 1961. Nonsuch Palace 1959-160: an Interim Report. *Surrey Archaeological Collections* 58: 1-20.

Biddle, M. & R. N. Quirk 1962. Excavations Near Winchester Cathedral, 1961. *Archaeological Journal* 119: 150-194.

Biller, P. P. A. 1982. Birth-Control in the West in the Thirteenth and Early Fourteenth Centuries. *Past and Present* 94: 3-26.

Blaffer Hrdy, S. 1992. Fitness Tradeoffs in the History and Evolution of Delegated Mothering with Special Reference to Wet-Nursing, Abandonment and Infanticide. *Ethnology and Sociobiology* 13: 409-42.

Blair, J. 2006. *The Church in Anglo-Saxon Society*. Oxford: Oxford University Press.

Blakely, R. 2009. India Welcomes More Baby Girls for First Time. The Times. Published 17th August 2009. http://www.timesonline.co.uk/tol/news/world/asia/article6798717.ece (consulted 26/10/2009).

Blakey, M. L., T. E. Leslie & J. P. Reidy 1994. Frequency and Chronological Distribution of Dental Enamel Hypoplasia in Enslaved African American: A Test of the Weaning Hypothesis. *American Journal of Physical Anthropology* 95: 371-383.

Blockley, K., M. Blockley, P. Blockley, S. Frere & S. Stow (eds) 1995. *Excavations in the Marlowe Car Park and Surrounding Areas* The Archaeology of Canterbury Volume 5: Canterbury Archaeological Trust.

Bocquet-Appel, J.-P. & C. Masset 1982. Farewell to Palaeodemography. *Journal of Human Evolution* 11: 321–333.

Boddington, A. 1996. *Raunds Furnells: The Anglo-Saxon Church and Churchyard*. London: English Heritage.

Boddington, A. 1987a. Raunds, Northamptonshire: Analysis of a Country Churchyard. *World Archaeology* 18(3): 411--425.

Boddington, A. 1987b. Chaos and Disturbance in an Anglo-Saxon Cemetery. In A. Boddington, A. N. Garland and R. C. Janaway (eds) *Death, Decay and Reconstruction: Approaches to Archaeology and Forensic Science*: 27-42. Manchester: Manchester University Press.

Boddington, A. 1987c. From Bones to Population: The Problem of Numbers. In A. Boddington, A. N. Garland and R. C. Janaway (eds) *Death, Decay and Reconstruction*: 180-197. Manchester: Manchester University Press.

Boddington, A., A. N. Garland & R. C. Janaway 1987. Flesh, Bones, Dust and Society. In A. Boddington, A. N. Garland and R. C. Janaway (eds) *Death, Decay and Reconstruction*: 3-9. Manchester: Manchester University Press.

Bogin, B. 1997. Evolutionary Hypotheses for Human Childhood. *Yearbook of Physical Anthropology* 40: 63-89.

Boocock, P. A., K. Manchester & C. Roberts 1995. *The Human Remains from Eccles, Kent*. University of Bradford Unpublished Skeletal Report:

Booth, P., A. Dodd, M. Robinson & A. Smith (eds) 2007. *The Thames Through Time: The Archaeology of the Gravel Terraces of the Upper and Middle Thames. The Early Historical Period: AD1-1000*. Oxford Archaeology: Thames Valley Landscapes Monograph No.27.

Boswell, J. 1989. *The Kindness of Strangers: The Abandonment of Children in Western Europe from Late Antiquity to the Renaissance*. London: Allen Lane The Penguin Press.

Boyes, R. 2008. Three Babies Found in Deep Freeze in Germany's Infanticide Epidemic. http://www.timesonline.co.uk/tol/news/world/europe/article3874969.ece *Times 6th May 2008* (consulted 26/10/2009).

Boyle, A. 1998. Synopsis: The Anglo-Saxon Cemetery and Later Activity. In A. Boyle, D. Jennings, D. Miles and S. Palmer (eds) *The Anglo-Saxon Cemetery at Butler's Field, Lechlade, Gloucestershire. Vol. 1: Prehistoric and Roman Activity and Grave Catalogue*: 35-42. Oxford Archaeological Unit, Oxford University Committee for Archaeology: Thames Valley Landscapes Monograph 10.

Boyle, A. & A. Dodd 1995. Discussion. In A. Boyle, A. Dodd, D. Miles and A. Mudd (eds) *Two Oxfordshire Anglo-Saxon Cemeteries: Berinsfield and Didcot*: 112-137. Oxford Archaeological Unit by Oxford University Committee for Archaeology: Thames Valley Landscapes Monograph No. 8.

Boyle, A., D. Jennings, D. Miles & S. Palmer 1998. *The Anglo-Saxon Cemetery at Butler's Field, Lechlade, Gloucestershire. Vol. 1: Prehistoric and Roman Activity and Grave Catalogue*. Oxford Archaeological Unit, Oxford University Committee for Archaeology: Thames Valley Landscapes Monograph 10.

Boyle, A. J., A. Dodd, D. Miles & A. Mudd 1995. *Two Oxfordshire Anglo-Saxon Cemeteries: Berinsfield and Didcot*. Oxford Archaeological Unit by Oxford University Committee for Archaeology: Thames Valley Landscapes Monograph No. 8.

Boylston, A. & C. Roberts 1996. The Human Bone. In M. Adams Excavation of a pre-Conquest Cemetery at Addingham, West Yorkshire. *Medieval Archaeology* 40: 173-180.

Bradley, R., R. A. Chambers & C. Halpin 1984. *Barrow Hills, Radley 1983-4: Excavations: an Interim Report*. Oxford: Oxford Archaeological Unit.

Brentano, R. 1966. *The Early Middle Ages, 500-1000* Sources in Western Civilisation. New York: Free Press, 1966, Collier-Macmillan.

Brickley, M. 2000. The Diagnosis of Metabolic Disease in Archaeological Bone. In M. Cox and S. Mays (eds) *Human Osteology in Archaeology and Forensic Science*: 183-198. London: Greenwich Medical Media.

Brickley, M. & R. Ives 2006. Skeletal Manifestations of Infantile Scurvy. *American Journal of Physical Anthropology* 129: 163-172.

Brittain, A. W., W. T. Morrill & J. A. Kurland 1988. Parental Choice and Infant Mortality in a West Indian Population. *Human Biology* 60(5): 679-692.

Brothwell, D. 1972. Palaeodemography and Earlier British Populations. *World Archaeology* 4(1): 75-87.

Brothwell, D. R. 1981. *Digging up Bones (3rd edn.)*. Ithaca, New York: Cornell University Press.

Browne, S. 1996. Human Burials. In M. Gardiner, M. Russell and D. Gregory (eds) *Excavations at Lewes Friary 1985-6 and 1988-9. Sussex Archaeological Collections*: 71-123. 134.

Bruce, M. & A. Cox 1995. The Human Skeletal Remains from Kinnoull Street. In D. Bowler, A. Cox and C. Smith (eds) *Four excavations in Perth, 1979-84 Proceedings of the Society of Antiquities Scotland*: 917-999. 125.

Bryant, R. M. & C. M. Heighway 1998. Historical and Topographical Background: The Topographical Development of the Site. In D. Wilkinson and A. McWhirr (eds) *Cirencester*

Anglo-Saxon Church and Medieval Abbey: 7-13. Cirencester Excavations IV: Cirencester: Cotswold Archaeological Trust Ltd.

Buckberry, J. L. 2008. Off With Their Heads: The Anglo-Saxon Execution Cemetery at Walkington Wold, East Yorkshire. In E. M. Murphy (ed.) *Deviant Burial in the Archaeological Record*: 148-168. Oxford: Oxbow Books.

Buckberry, J. L. 2007. On Sacred Ground: Social Identity and Churchyard Burial in Lincolnshire and Yorkshire, c. 700-1100 AD. In H. Williams and S. Semple (eds) *Anglo-Saxon Studies in Archaeology and History 14*: 117-129. Oxford: Oxford University School of Archaeology.

Buckberry, J. L. 2000. Missing, Presumed Buried? Bone Diagenesis and the Under-Representation of Anglo-Saxon Children. *Assemblage* 5: 1-8.

Buckberry, J. L. & D. M. Hadley 2001. Fieldwork at Chapel Road, Fillingham. *Lincolnshire History and Archaeology* 36: 11-18.

Buikstra, J. E. & J. H. Mielke 1985. Demography, Diet and Health. In R. I. Gilbert and J. H. Mielke (eds) *The Analysis of Prehistoric Diets*: 359-422. London: Academic Press Inc.

Buikstra, J. E. & D. H. Ubelaker 1994. *Standards for Data Collection from Human Skeletal Remains*. Arkansas Archaeological Survey Research Series 44. Fayetteville: Arkansas Archaeological Survey.

Butler, N. R. & E. D. Alberman 1969. *Perinatal Problems: the Second Report of the 1958 Perinatal Mortality Survey*. Edinburgh: Livingstone.

Caldwell, J. 2005. On Net Intergenerational Wealth Flows: An Update. *Population Development Review* 31(4): 721–40.

Caldwell, J. 1980. Mass Education as a Determinant of the Timing of Fertility Decline. *Population Development Review* 6: 225–255.

Caldwell, J. 1976. Toward a Restatement of Demographic Transition Theory. *Population Development Review* 2: 321–366.

Campbell, J. 1986. *Essays in Anglo-Saxon History*. London: Hambledon Press.

Candib, L. M. 1999. Incest and Other Harms to Daughters Across Cultures: Maternal Complicity and Patriarchal Power. *Women's Studies International Forum* 22(2): 185-201.

Canon, A. 1995. Material Culture and Burial Representatives. In S. R. Saunders and A. Herring (eds) *Grave Reflections: Portraying the Past through Cemetery Studies*: 3–17. Toronto: Canadian Scholars' Press.

Carter, A. 1997. Infanticide and the Right to Life. *Ratio* 10: 1-9.

Chadwick Hawkes, S. 1976. Orientation at Finglesham: Sunrise Dating of Death and Burial in an Anglo-Saxon Cemetery in East Kent. *Archaeologia Cantiana* 95: 33-51.

Chadwick Hawkes, S. 1958. The Anglo-Saxon Cemetery at Finglesham, Kent: A Reconsideration. *Medieval Archaeology* ii: 1-71.

Chadwick Hawkes, S. & G. Grainger 2003. *The Anglo Saxon Cemetery at Worthy Park, Kingsworthy near Winchester, Hampshire* Oxford University School of Archaeology: Monograph No. 59.

Chadwick Hawkes, S. & M. Gray 1969. Preliminary Note on the Early Anglo-Saxon Settlement at New Wintles Farm, Eynsham. *Oxoniensia* 34: 1-4.

Chagnon, N. A., M. V. Flinn & T. F. Melancon 1979. Sex-Ratio Variation among the Yąnomamö Indians. In N. A. C. W. Irons (ed.) *Evolutionary Biology and Human Social Behaviour: An Anthropological Perspective*: 290-320. North Scituate, Massachusetts: Duxbury Press.

Chamberlain, A. 2000a. Problems and Prospects in Palaeodemography. In M. Cox and S. Mays (eds) *Human Osteology in Archaeology and Forensic Science*: 101-115. London: Greenwich Medical Media.

Chamberlain, A. 2000b. Minor Concerns: a Demographic Perspective on Children in Past Societies. In J. S. Derevenski (ed.) *Children and Material Culture*: 206-212. London: Routledge.

Chamberlain, A. T. 2006. *Demography in Archaeology*. Cambridge: Cambridge University Press.

Chamberlain, A. T. 1997. Commentary: Missing Stages of Life – Towards the Perception of Children in Archaeology. In E. S. J. Moore (ed.) *Invisible People and Processes: Writing Gender and Childhood into European Archaeology*: 248-257. London: Leicester University Press.

Chambers, R. A. 1987. The Late- and Sub-Roman Cemetery at Queenford Farm, Dorchester-on-Thames, Oxon. *Oxoniensia* 52: 35-69.

Chambers, R. A. 1973. A Cemetery Site at Beacon Hill, near Lewknor. *Oxoniensia* 38: 138-145.

Cherryson, A. 2007. Disturbing the Dead: Urbanisation, the Church and the Post-Burial Treatment of Human Remains in Early Medieval Wessex, c. 600-1100 AD. In H. Williams and S. Semple (eds) *Anglo-Saxon Studies in Archaeology and History 14*: 130-142. Oxford: Oxford University School of Archaeology.

Cherryson, A. K. 2008. Normal, Deviant and Atypical: Burial Variation in Late Anglo-Saxon Wessex, c. AD 700-1100. In E. M. Murphy (ed.) *Deviant Burial in the Archaeological Record*: 115-130. Oxford: Oxbow Books.

Choe, M. K., I. Diamond, F. A. Steele & S. K. Kim 1998. Son Preference, Family Building Process and Child Mortality. In U. Nations (ed.) *Too Young to Die: Genes or Gender?*: 208-222. New York: United Nations Department of Economic and Social Affairs.

Christensen, K., K. H. Orstavik & J. W. Vaupel 2001. The X Chromosome and the Female Survival Advantage: An Example of the Intersection Between Genetics, Epidemology and Demography. *Annuals of the New York Academy of Sciences* 954: 175-183.

Ciocca, A. 1940a. Sex Differences in Morbidity and Mortality (Concluded). *Quarterly Review of Biology* 15(2): 192-210.

Ciocca, A. 1940b. Sex Differences in Morbidity and Mortality. *Quarterly Review of Biology* 15(1): 59-73.

Clark, E. 1994. Mothers at Risk of Poverty in the Medieval English Countryside. In J. Henderson and R. Wall (eds) *Poor Women and Children in the European Past*: 139-159. London: Routledge.

Clark, S. 2000. Son Preference and Sex Composition of Children: Evidence from India. *Demography* 37: 95-108.

Clayton, N. B. 1973. New Wintles, Eynsham, Oxon. *Oxoniensia* 38: 382-384.

Clough, S. 2006. Excavations at the Litten Medieval Cemetery, Newbury, Berkshire. *Church Archaeology* 10: 105-108.

Clough, S. & L. Loe 2005. *New Romney, St. Martin's Field. Skeletal Assessment - NRSMEX05*. Oxford Archaeology Heritage Burial Services Unpublished Skeletal Report.

Clunies Ross, M. 1985. Concubinage in Anglo-Saxon England. *Past and Present* 108: 3-34.

Clutton-Brock, T. 1982. Sons and Daughters. *Nature* 298(1): 11-13.

Coale, A. 1974. The History of Human Population. *Scientific American* 231: 40-51.

Coale, A. J. 1991. Excess Female Mortality and the Balance of the Sexes in the Population: An Estimate of the Number of “Missing Females”. *Population and Development Review* 17: 517-523.

Cockayne, T. O. 1961a. *Leechdoms, Wortcunning and Starcraft of Early England: being a collection of Documents, for the most part never before printed, Illustrating the History of Science in this Country before the Norman Conquest*. Volume 2. London: The Holland Press.

Cockayne, T. O. 1961b. *Leechdoms, Wortcunning and Starcraft of Early England: being a collection of Documents, for the most part never before printed, Illustrating the History of Science in this Country before the Norman Conquest*. Volume 3. London: The Holland Press.

Cockayne, T. O. 1961c. *Leechdoms, Wortcunning and Starcraft of Early England: being a collection of Documents, for the most part never before printed, Illustrating the History of Science in this Country before the Norman Conquest*. Volume 1. London: The Holland Press.

Cockburn, J. S. 1991. Patterns of Violence in English Society: Homicide in Kent 1560-1985. *Past & Present* 130: 70-106.

Coleman, E. R. 1976. Infanticide in the Early Middle Ages. In S. Mosher-Stuard (ed.) *Women in Medieval Society*: 47-70. Pennsylvania: The University of Pennsylvania Press.

Coleman, E. R. 1971. Medieval Marriage Characteristics: A Neglected Factor in the History of Medieval Serfdom. *Journal of Interdisciplinary History* 2: 205-219.

Colgrave, B. 1927. *The Life of Bishop Wilfred by Eddius Stephanus*. Cambridge: Cambridge University Press.

Conheeney, J. 2004. The Human Bones. In B. Sloane and G. Malcolm (eds) *Excavations at the Priory of the Order of the Hospital of St John of Jerusalem, Clerkenwell*. London: MoLAS Monograph Service 20.

Cook, A. M. & M. W. Dacre 1985. *Excavations at Portway, Andover 1973-1975 : Anglo-Saxon cemetery, Bronze Age barrow and linear ditch*. Oxford: Oxford University Committee for Archaeology.

Cook, D. C. & J. E. Buikstra 1979. Health and Differential Survival in Prehistoric Populations: Prenatal Dental Defects. *American Journal of Physical Anthropology* 51: 649-664.

Cook, R. & A. Hanslip 1964. Nutrition and Mortality of Females Under Five Years of Age Compared with Males in the Greater Syria Region. *Journal of Tropical Pediatrics* 10: 76-81.

Corbier, M. 1991. Constructing Kinship in Rome: Marriage and Divorce, Filiation and Adoption. In D. I. Kertzer and R. P. Saller (eds) *The Family in Italy: From Antiquity to the Present*: 127-144. New Haven: Yale University Press.

Cowal, L. 2007. http://www.museumoflondon.org.uk/English/Collections/OnlineResources/CHB/Database/Medieval+cemeteries/GuildhallYard.htm *accessed 28/05/08*.

Cowgill, U. M. & G. E. Hutchinson 1963. Differential Mortality Among the Sexes in Childhood and its Possible Significance in Human Evolution. *Proceedings of the National Academy of Sciences of the USA* 49(4): 425–429.

Cowlishaw, G. 1978. Infanticide in Aboriginal Australia. *Oceania* 48(4): 262-283.

Craig, E. F. 2006. *An Osteological and Palaeopathological Assessment of Stress Indicators and Social Status at Raunds Furnells, Northamptonshire*. University of Bradford Unpublished MSc Dissertation.

Crawford, S. 2001. Children. In M. Lapidge, J. Blair, S. Keynes and D. Scragg (eds) *The Blackwell Encyclopaedia of Anglo-Saxon England*: 103-104. Oxford: Blackwell.

Crawford, S. 1999. *Childhood in Anglo-Saxon England*. Stroud: Sutton Publishing.

Crawford, S. 1991. When do Anglo-Saxon Children Count? *Journal of Theoretical Archaeology* 2: 17-24.

Croll, E. J. 2000. *Endangered Daughters: Discrimination and Development in Asia*. London: Routledge.

Cronk, L. 1991. Human Behavioral Ecology. *Annual Review of Anthropology* 20: 25-53.

Cross, J. F. & M. F. Bruce 1989. The Skeletal Remains. In *Three Scottish Carmelite Friaries: Aberdeen, Linlithgow and Perth*: 119-142. Society Of Antiquaries Of Scotland Edinburgh: Monograph Series Number 6.

Cunliffe, B. 1993. *Wessex to A.D. 1000* A Regional History of England. London: Longman.

Dahlberg, G. 1947. *Statistical Methods for Medical and Biological Students*. Woking: Unwin Brothers.

Daly, M. & M. Wilson 1984. A Sociobiological Analysis of Human Infanticide. In G. Hausfater and S. B. Hrdy (eds) *Infanticide: Comparative and Evolutionary Perspectives*: 487-502. New York: Aldine Publishing Company.

Damme, C. 1978. Infanticide: The Worth of an Infant Under Law. *Medical History* 22: 1-24.

Danforth, M. E. 1999. Nutrition and Politics in Prehistory. *Annual Review of Anthropology* 28: 1-25.

Daniell, C. 1997. *Death and Burial in Medieval England: 1066-1550*. London: Routledge.

Darwin, C. R. 1874. *The Descent of Man and Selection in Relation to Sex*. 2nd edn. New York: Hurst & Company.

Dasen, V. 1997. Multiple Births in Graeco-Roman Antiquity. *Oxford Journal of Archaeology* 16(1): 49-63.

Davis, K. 1955. Institutional Patterns Favoring High Fertility in Underdeveloped Areas. *Eugenics Q* 2: 33-39.

Dawes, J. D. 1980. The Human Bones. In J. D. Dawes and J. R. Magilton (eds) *The Cemetery of St. Helen-on-the-Walls, Aldwark - The Archaeology of York - The Medieval Cemeteries 12/1*. York: Council for British Archaeology for the York Archaeological Trust.

Dawes, J. D. & J. R. Magilton 1980. *The Cemetery of St. Helen-on-the-Walls, Aldwark - The Archaeology of York - The Medieval Cemeteries 12/1*. York.: Council for British Archaeology for the York Archaeological Trust.

Delany, S. 1994. *The Naked Text: Chaucer's Legend Of Good Women*. Oxford: University of California Press.

DeMause, L. 1974. The Evolution of Childhood. In L. DeMause (ed.) *The History of Childhood*: 1-73. New York: The Psychohistory Press.

Demirjian, A. 1978. Dentition. In F. Falkner and J. M. Tanner (eds) *Human Growth vol. 2, Postnatal Growth*: 413-444. London: Plenum Press.

Demirjian, A., H. Goldstein & J. M. Tanner 1973. A New System of Dental Age Assessment. *Human Biology* 45: 211–222.

Denston, R. B. 1957. The Human Remains. In Evison, V. An Anglo-Saxon Cemetery at Holborough, Kent. *Archaeologia Cantiana* 70: 84-141.

Dettwyler, K. A. 1995. A Time to Wean: The Hominid Blueprint for the Natural Age of Weaning in Modern Human Populations. In P. Stuart-Macadam and K. A. Dettwyler (eds) *Breastfeeding: Biocultural Perspectives*: 39-73. New York: Aldine de Gruyter.

Dettwyler, K. A. & C. Fishman 1992. Infant Feeding Practices and Growth. *Annual Review of Anthropology* 21: 171– 204.

DeVito, C. & S. R. Saunders 1990. A Discriminant Function Analysis of Deciduous Teeth to Determine Sex. *Journal of Forensic Science* 35(4): 845-58.

Devlin, Z. 2007. *Remembering the Dead in Anglo-Saxon England: Memory Theory in Archaeology and History*. Oxford: Archaeopress: BAR British Series 446

Diack, M. 2006. New Romney Sewer Scheme. *Canterbury's Archaeology* 2005-2006: 34.

Diack, M. 2004. Canterbury Archaeological Trust. 2004. Annual Report 28, 2003: Bradstow School, Broadstairs http://www.canterburytrust.co.uk/annreps/annreps.htm , . *Canterbury Archaeological Trust*.

Dickemann, M. 1984. Concepts and Classification in the Study of Human Infanticide: Sectional Introduction and some Cautionary Notes. In G. Hausfater and S. B. Hrdy (eds) *Infanticide: Comparative and Evolutionary Perspectives*: 427-437. New York: Aldine Publishing Company.

Dickemann, M. 1979a. The Ecology of Mating Systems in Hypergynous Dowry Societies. *Social Science Information* 18(2): 163-195.

Dickemann, M. 1979b. Female Infanticide, Reproductive Strategies, and Social Stratification: A Preliminary Model. In N. A. Chagnon and W. Irons (eds) *Evolutionary Biology and Human Social Behaviour: An Anthropological Perspective*: 321-367. North Scituate, Massachusetts: Duxbury Press.

Dickemann, M. 1975. Demographic Consequences on Infanticide in Man. *Annual Review of Ecology and Systematics* 6: 107-137.

Dickinson, J. R. & J. A. Sharpe 2002. Infanticide in Early Modern England: the Court of Great Sessions and Chester, 1650-1800. In M. Jackson (ed.) *Infanticide: Historical Perspectives on Child Murder and Concealment, 1550-2000*: 35-51. Aldershot Ashgate.

Didsbury, P. 1998. A Mammiform Vessel. In M. F. G. Drinkall (ed.) *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber. Sheffield Excavation Reports 6*: 309-311. Sheffield: Sheffield Academy Press Ltd., Humber Archaeology Partnership, .

Divale, W. T. & M. Harris 1976. Population, Warfare and the Male Supremacist Complex. *American Anthropologist* 78: 521-538.

Djuric, M., P. Milovanovic, A. Janovic, M. Draskovic, K. Djukic & P. Milenkovic 2008. Porotic Lesions in Immature Skeletons from Stara Torina, Late Medieval Serbia. *International Journal of Osteoarchaeology* 18: 458-475.

Donaldson, J. 1907. *Woman; Her Position and Influence in Ancient Greece and Rome and Among the Early Christians*. London: Longmans, Green & Co.

Donnelly, C. J. & E. M. Murphy 2008. The Origins of *Cillini* in Ireland In Murphy (ed.) *Deviant Burial in the Archaeological Record*.

Dórea, J. G. 2002. Zinc Deficiency in Nursing Infants. *Journal of the American College of Nutrition* 21(2): 84-87.

Douglas, M. 1966. Population Control in Primitive Groups. *British Journal of Sociology* 27: 263-273.

Dowling, Á. 2005. *A Comparison of Maxillary and Mandibular Dental Development*. University of Bradford Unpublished MSc Dissertation.

Down, A. & M. Welch (eds) 1990. *Apple Down and the Mardens*. Chichester Excavations VII: Chichester District Council.

Downer, L. J. (ed.) 1972. *Leges Henrici Primi*. Oxford: Clarendon Press.

Drewett, P., D. Rudling & M. Gardiner 1988. *The South East to AD 1000*. London: Longman.

Duby, G. 1998. *Women of the Twelfth Century*. Cambridge: Polity Press.

DuckworthLaboratory 2009. *Comet Place Site Archive* consulted 17/07/09. Cambridge: Duckworth Laboratory.

Duhig, C. 2003. Human Skeletal Material. In H. Duncan, C. Duhig & M. Philips, A Late Migration / Final Phase Cemetery at Water Lane, Melbourn. *Proceedings of the Cambridge Antiquarian Society* 92: 95-97.

Duhig, C. 1998. The Human Skeletal Material. In T. Malim and J. Hines (eds) *The Anglo-Saxon Cemetery at Edix Hill (Barrington A), Cambridgeshire*. York: Council for British Archaeology Research Report 112.

Duhig, C. 1996. Human Skeletal Remains. In N. Oakey & P. Spoerry. Excavations at Orchard Lane, Huntingdon, 1994. *Proceedings of the Cambridge Antiquarian Society* 85: 144-147.

Dupras, T. L., H. P. Schwarcz & S. I. Fairgrieve 2001. Infant Feeding and Weaning Practices in Roman Egypt. *American Journal of Physical Anthropology* 115: 204–212.

Duray, S. M. 1996. Dental Indicators of Stress and Reduced Age at Death in Prehistoric Native Americans. *American Journal of Physical Anthropology* 99: 275-286.

Dyer, C. 1989. *Standards of Living in the Later Middle Ages: Social Change in England c. 1200-1520*. Cambridge: Cambridge University Press.

Eccles, A. 1982. *Obstetrics and Gynaecology in Tudor and Stuart England*. London: Croom Helm.

Edlund, L. 1999. Son Preference, Sex Ratios, and Marriage Patterns. *The Journal of Political Economy* 107(6): 1275-1304.

Edwards, M. 1996. The Cultural Context of Deformity in the Ancient Greek World. *Ancient History Bulletin* 10(3-4): 79-92.

Eisenberg, L. E. 1992. Comments on: Wood, J.W., G.R. Milner, H.C. Harpending & K.M. Weiss 1992.The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples. *Current Anthropology* 33: 359-60.

Ellison, P. T. 1994. Advances in Human Reproductive Ecology. *Annual Review of Anthropology* 23: 255-275.

Emmison, F. G. 1970. *Elizabethan Life: Disorder mainly from Essex Sessions and Assize Records*. Chelmsford: Essex County Council.

Engels, D. 1984. The Use of Historical Demography in Ancient History. *The Classical Quarterly, New Series* 34(2): 386-393.

Evison, V. 1987. *Dover: The Buckland Anglo-Saxon Cemetery*. London: Historic Buildings and Monuments Commission Report 3.

Evison, V. 1957. An Anglo-Saxon Cemetery at Holborough, Kent. *Archaeologia Cantiana* 70: 84-141.

Evison, V. & P. Hill 1996. *Two Anglo-Saxon Cemeteries at Beckford, Hereford and Worcester*. York: Council for British Archaeology Research Report 103.

Evison, V. I. 1994. *An Anglo-Saxon Cemetery at Great Chesterford, Essex*. Council for British Archaeology Research Report 91.

Evison, V. I. 1988. *An Anglo-Saxon Cemetery at Alton, Hampshire*. Hampshire Field Club and Archaeological Society: Monograph 4.

Fábrega, H. J. 1997. *Evolution of Sickness and Healing*. Oxford: University of California Press.

Faerman, M., G. K. Bar-Gal, D. Filon, C. L. Greenblatt, L. Stager, A. Oppenheim & P. Smith 1998. Determining the Sex of Infanticide Victims from the Late Roman Era through Ancient DNA Analysis. *Journal of Archaeological Science* 25: 861-865.

Fairgrieve, S. I. & J. E. Molto 2000. Cribra Orbitalia in Two Temporally Distinct Population Samples From the Dakhleh Oasis, Egypt. *American Journal of Physical Anthropology* 111: 319–331.

Fathalla, M. F. 2000. The Girl Child. *International Journal of Gynecology and Obstetrics* 70: 7-12.

Fehling, H. 1876. Die Form des Beckens beim Fotus und Neugeborenen und ihre Beziehung zu der beim Erwachsenen. *Arch. Gynäk* 10: 1-80.

Fell, C., C. Clark & E. Williams 1984. *Women in Anglo-Saxon England: and the impact of 1066*. London: British Museum.

Ferembach, D., I. Schwidetzky & M. Stloukal 1980. Recommendations for Age and Sex Diagnosis of Skeletons. *Journal of Human Evolution* 9: 517-549.

Fildes, V. A. 1995. The Culture and Biology of Breastfeeding: An Historical Review of Western Europe. In P. Stuart-Macadam and K. A. Dettwyler (eds) *Breastfeeding: Biocultural Perspectives*: 101-126. New York:: Aldine de Gruyter.

Finucane, R. C. 1981. Sacred Corpse, Profane Carrion: Social Ideals and Death Rituals in the Later Middle Ages. In J. Whaley (ed.) *Mirrors of Mortality: Studies in the Social History of Death*: 40-60. London: Europa Publications Limited.

Finucane, R. C. 1977. *Miracles and Pilgrims: Popular Beliefs in Medieval England*. London: J.M. Dent & Sons Ltd.

Fisher, R. A. 1930. *The Genetical Theory of Natural Selection*. Oxford: Clarendon Press.

Flandrin, J.-L. & R. Southern 1979. *Families in Former Times: Kinship, Household and Sexuality* Themes in the Social Sciences. Cambridge: Cambridge University Press.

Fleiss, J. L. 1973. *Statistical Methods for Rates and Proportions*. New York: John Wiley & Sons, Inc.

Fleiss, J. L. 1971. Measuring Nominal Scale Agreement Among Many Raters. *Psychological Bulletin* 76(5): 378-382.

Fletcher, J. 1978. Infanticide and the Ethics of Loving Concern. In M.Kohl (ed.) *Infanticide and Value of Life*: 13-22. Buffalo, New York: Prometheus Books.

Fletcher, J. 1975. Abortion, Euthanasia, and Care of Defective Newborns. *The New England Journal of Medicine* 292: 75-78.

Foot, S. 1992. 'By Water in the Spirit': The Administration of Baptism in Early Anglo-Saxon England. In J. Blair and R. Sharpe (eds) *Pastoral Care Before the Parish*: 171-192. Leicester: Leicester University Press.

Freeman, M. 1971. A Social and Economic Analysis of Systematic Female Infanticide Among the Netsilik Eskimo. *American Anthropologist* 73: 1011-1018.

Fuller, B. T., J. L. Fuller, D. A. Harris & R. E. M. Hedges 2006a. Detection of Breastfeeding and Weaning in Modern Human Infants with Carbon and Nitrogen Stable Isotope Ratios. *American Journal of Physical Anthropology* 129: 279–293.

Fuller, B. T., T. I. Molleson, D. A. Harris, L. T. Gilmour & R. E. M. Hedges 2006b. Isotopic Evidence for Breastfeeding and Possible Adult Dietary Differences from Late/Sub- Roman Britain. *American Journal of Physical Anthropology* 129: 45–54.

Fuse, K. & E. M. Crenshaw 2006. Gender Imbalance in Infant Mortality: A Cross-national Study of Social Structure and Female Infanticide. *Social Science & Medicine* 62: 360-374.

Garland, R. 1995. *The Eye of the Beholder: Deformity and Disability in the Graeco-Roman World*. London: Duckworth.

Garmonsway, G. N. 1953. *The Anglo-Saxon Chronicle*. London: Dent.

Garnsey, P. 1999. *Food and Society in Classical Antiquity*. Cambridge: Cambridge University Press.

Gaskill, M. 1996. The Displacement of Providence: Policing and Prosecution in Seventeenth- and Eighteenth-Century England. *Continuity and Change* 11(5): 341-374.

Geake, H. 1997. *The Use of Grave-Goods in Conversion Period England, c.600-850*. British Archaeological Reports: British Series 261.

Genovés, S. 1970. Sex Determination in Earlier Man. In D. B. E. Higgs (ed.) *Science in Archaeology*. London: Thames and Hudson.

Giladi, A. 1990. Some Observations on Infanticide in Medieval Muslim Society. *International Journal of Middle East Studies* 22(2): 185-200.

Gilchrist, R. & B. Sloane 2005. *Requiem: The Medieval Monastic Cemetery in Britain*. London: Museum of London Archaeology Service.

Ginsburg, F. & R. Rapp 1991. The Politics of Reproduction. *Annual Review of Anthropology* 20: 311-343.

Gittos, H. 2002. Creating the Sacred: Anglo-Saxon Rites for Consecrating Cemeteries. In S. Lucy and A. Reynolds (eds) *Burial in Early Medieval England and Wales*: 195-208. London: The Society for Medieval Archaeology Monograph Series No 17.

Given-Wilson, C. & A. Curteis 1984. *The Royal Bastards of Medieval England*. London: Routledge & Kegan Paul.

Glencross, B. & P. Stuart-Macadam 2000. Childhood Trauma in the Archaeological Record. *International Journal of Osteoarchaeology* 10: 198-209.

Glover, J. 1977. *Causing Death and Saving Lives*. London: Penguin Books.

Goldberg, P. J. P. 2006. Life and Death: the Ages of Man. In R. Horrox and W. M. Ormrod (eds) *A Social History of England 1200-1500*: 413-434. Cambridge: Cambridge University Press.

Goodman, A. H. 1993. On the Interpretation of Health from Skeletal Remains. *Current Anthropology* 34(3): 281-288.

Goodman, A. H. & G. J. Armelagos 1989. Infant and Childhood Morbidity and Mortality Risks in Archaeological Populations. *World Archaeology* 21: 225-243.

Goody, J. 2000. *The European Family: An Historico-Anthropological Essay*. Oxford: Blackwell Publishers.

Goody, J. 1983. *The Development of the Family and Marriage in Europe*. Cambridge: Cambridge University Press.

Gordon, C. C. & J. E. Buikstra 1981. Soil pH, Bone Preservation, and Sampling Bias at Mortuary Sites. *American Antiquity* 46: 566 – 571.

Gordon, E. C. 1991. Accidents Among Medieval Children as seen from the Miracles of Six English Saints and Martyrs. *Medical History* 35: 145-163.

Gordon, E. C. 1986. Child Health in the Middle Ages as Seen in the Miracles of Five English Saints, A.D. 1150-1220. *Bulletin of the History of Medicine* 60: 502-22.

Gowing, L. 1997. Secret Births and Infanticide in Seventeenth-Century England. *Past and Present* 156: 87-115.

Gowland, R. & C. J. Knüsel 2006. Introduction. In R. Gowland and C. Knüsel (eds) *Social Archaeology of Funerary Remains*: ix-xiv. Oxford: Oxbow.

Gowland, R. L. & A. T. Chamberlain 2003. A New Method for Estimating Gestational Age from Skeletal Long Bone Length. In K. A. Robson-Brown (ed.) *Archaeological Sciences 1999*: 42-58. BAR International Series 1111. Oxford: Archaeopress

Gowland, R. L. & A. T. Chamberlain 2002. A Bayesian Approach to Ageing Perinatal Skeletal Material from Archaeological Sites: Implications for the Evidence for Infanticide in Roman-Britain. *Journal of Archaeological Science* 29: 677-685.

Graham, D. 1994. Female employment and infant mortality: some evidence from British towns, 1911, 1931 and 1951. *Continuity and Change* 9(2): 313-346.

Grainger, I., D. Hawkins, P. Falcini & P. Mills 1988. Excavations at the Royal Mint Site 1986-1988. *London Archaeologist* 5(16): 429-436.

Granzberg, G. 1973. Twin Infanticide – A Cross-Cultural Test of a Materialistic Explanation. *Ethos* 1(4): 405-412.

Grauer, A. L. 1991. Life Patterns of Women from Medieval York. In D. Walde and N. D. Willows (eds) *Proceedings of the 22nd Annual Charcmool Conference, Charcmool, Canada*: 407-413. Calgary: Archaeological Association of the University of Calgary.

Graunt, J. 1662. *Natural and Political Observations*. London: T. Roycroft.

Gray, H. & H. V. Carter 2003. *Gray's Anatomy*. Bath: Parragon.

Guttentag, M. & P. F. Secord 1983. *Too Many Women? The Sex Ratio Question*. London: Sage Publications.

Guy, H., C. Masset & C.-A. Baud 1997. Infant Taphonomy. *International Journal of Osteoarchaeology* 7: 221-229.

Hackett, C. J. 1981. Development of Cries Sicca in a Dry Calvaria. *Virchow's Archives A (Pathological Anatomy)* 391: 53-79.

Hadley, D. 2007. The Garden gives up its Secret: the Developing Relationship between Rural Settlements and Cemeteries c. 800-1100. In H. Williams and S. Semple (eds) *Anglo-Saxon Studies in Archaeology and History*: 194-203 14. Oxford: Oxford University School of Archaeology.

Hadley, D. 2004. Gender and Burial Practices in England, c.650-900. In L. Brubaker and J. Smith (eds) *Gender in the Early Medieval World: East and West. 300-900*: 301-23 Cambridge: Cambridge University Press.

Hadley, D. 2001. *Death in Medieval England: An Archaeology*. Stroud: Tempus Publishing Ltd.

Hadley, D. 2000. Fear and Fantasy: Sexual Physiology and Late Medieval Society. In L. Bevan (ed.) *Indecent Exposure. Sexuality, Society and the Archaeological Record*: 179-200 London: Cruithne Press.

Hadley, D. & J. Buckberry 2005. Caring for the Dead in Late Anglo-Saxon England. In F. Tinti (ed.) *Pastoral Care in Late Anglo-Saxon England*: 121-147. Woodbridge: Boydell

Hajian-Tilaki, K. O. 2002. Factors Affecting the Pattern of Postpartum Amernorrhea. *Annals of Saudi Medicine* 22(5-6): 404-407.

Hall, S. 2005. *Neonatal Mortality in Developing Countries: What can we Learn from DHS Data? Southampton, Southampton Statistical Sciences Research Institute* (Applications & Policy Working Paper, A05/02; http://eprints.soton.ac.uk/14214, accessed 31/07/2006).

Hamerow , H. 2006. 'Special Deposits' in Anglo-Saxon Settlements. *Medieval Archaeology* 50: 1-30.

Hammer, C. I. 1978. Patterns of Homicide in a Medieval University Town: Fourteenth Century Oxford. *Past and Present* 78: 3-23.

Hanawalt, B. A. 1998. *'Of Good and Ill Repute' : Gender and Social Control in Medieval England*. Oxford: Oxford University Press.

Hanawalt, B. A. 1993. *Growing up in Medieval London: The Experience of Childhood in History*. Oxford: Oxford University Press.

Hanawalt, B. A. 1986. *The Ties That Bound: Peasant Families in Medieval England*. Oxford: Oxford University Press.

Hanawalt, B. A. 1977. Child Rearing Among the Lower Classes of Late Medieval England. *Journal of Interdisciplinary History* 8: 20-22.

Hanawalt, B. A. 1976a. Violent Death in Fourteenth- and Early Fifteenth-Century England. *Comparative Studies in Society and History* 18(3): 297-320.

Hanawalt, B. A. 1976b. The Female Felon in Fourteenth-Century England. In S. Mosher-Stuard (ed.) *Women in Medieval Society*: 125-140. Pennsylvania: The University of Pennsylvania Press.

Harden, D. B. & R. C. Treweeks 1945. Excavations at Stanton Harcourt, Oxon., 1940, II. *Oxoniensia* 10: 16-41.

Hardy, A., A. Dodd & D. G. Keevil 2003. *Aelfrics Abbey: Excavations at Eynsham Abbey, Oxfordshire, 1989-92* Thames Valley Landscapes Volume 16. Oxford Oxford Archaeology.

Hardy, E. & M. Y. Makuch 2006. Gender, Infertility and Art. World Health Organisation http://www.who.int/reproductive-health/infertility/26.pdf consulted 24/07/2006.

Härke, H. 1997. Early Anglo-Saxon Social Structure. In J. Hines (ed.) *The Anglo-Saxons from the Migration Period to the 8th Century: an Ethnographic Perspective*: 125-170. Woodbridge: Boydell Press.

Harkness, S. & C. M. Super 1987. Fertility Change, Child Survival, and Child Development: Observations on a Rural Kenyan Community. In N. Scheper-Hughes (ed.) *Child Survival: Anthropological Perspectives on the Treatment and Maltreatment of Children*: 59-70. Boston: D Reidel Publishing Company.

Harman, M. 1998. The Human Remains. In A. Boyle, D. Jennings, D. Miles and S. Palmer (eds) *The Anglo-Saxon Cemetery at Butler's Field, Lechlade, Gloucestershire. Vol. 1: Prehistoric and Roman Activity and Grave Catalogue*: 43-52. Oxford Archaeological Unit, Oxford University Committee for Archaeology: Thames Valley Landscapes Monograph 10.

Harman, M. 1992. Human Bone from 1983. In C. Scull (ed.) *Excavation and Survey at Watchfield, Oxfordshire, 1983-92*: 124-281. 149. Archaeological Journal.

Harman, M. 1990. The Human Remains. In A. Down and M. Welch (eds) *Apple Down and the Mardens*: 183-213. Chichester Excavations VII: Chichester District Council.

Harman, M. 1976. The Human Bones In R.A. Chambers, The Cemetery Site at Beacon Hill, near Lewknor, Oxon. 1972 (M40 Site 12): An Inventory of the Inhumations and a Re-appraisal. *Oxoniensia* 41: 77-85.

Harris, H. A. 1933. *Bone Growth in Health and Disease*. London: Oxford University Press.

Hassan, F. A. 1979. Demography and Archaeology. *Annual Review of Anthropology* 8: 137-160.

Haughton, C. & D. Powlesland 1999. *West Heslerton Anglian Cemetery*. Yedingham, North Yorkshire: Landscape Research Centre Archaeology.

Hausfater, G. & S. B. Hrdy 1984. Comparative and Evolutionary Perspectives on Infanticide: Introduction and Overview. In G. Hausfater and S. B. Hrdy (eds) *Infanticide: Comparative and Evolutionary Perspectives*: xiii-xxxv. New York: Aldine Publishing Company.

Hawkes, S. E. & C. Wells 1983. The Inhumed Skeletal Material from an Early Anglo-Saxon Cemetery at Worthy Park, Kingsworthy, Hampshire, South England. *Paleobios* 1: 3-36.

Heighway, C. & R. Bryant 1999. *The Golden Minster: The Anglo-Saxon Minster and Later Medieval Priory of St Oswald at Gloucester*. London: Council for British Archaeology Research Report 117.

Heighway, C. & M. Hare 1999. Gloucester and the Minster of St Oswald: A Survey of the Evidence. In C. Heighway and R. Bryant (eds) *The Golden Minster: The Anglo-Saxon Minster and Later Medieval Priory of St Oswald at Gloucester*: 1-46. London: Council for British Archaeology Research Report 117.

Heighway, C., M. Harman, L. Viner & D. J. Wilkinson 1998. The Burials. In D. Wilkinson and A. McWhirr (eds) *Cirencester Anglo-Saxon Church and Medieval Abbey*: 163-167. Cirencester Excavations IV: Cirencester: Cotswold Archaeological Trust Ltd.

Helmholtz, R. H. 1975. Infanticide in the Province of Canterbury during the Fifteenth Century. *History of Childhood Quarterly* 11: 379-390.

Henderson, J. 1987. Factors Determining the State of Preservation of Human Remains. In A. Boddington, A. N. Garland and R. C. Janaway (eds) *Death, Decay and Reconstruction: Approaches to Archaeology and Forensic Science*: 43-50. Manchester: Manchester University Press.

Henderson, J. D. & C. Wells 1985. The Human Remains. In A. M. Cook and M. W. Dacre (eds) *Excavations at Portway, Andover 1973-1975 : Anglo-Saxon Cemetery, Bronze Age Barrow and Linear Ditch*: 61-71. Oxford: Oxford University Committee for Archaeology.

Herlihy, D. 1985. *Medieval Households*. London: Harvard University Press.

Herring, D. A., S. R. Saunders & M. A. Katzenberg 1998. Investigating the Weaning Process in Past Populations. *American Journal of Physical Anthropology* 105: 425–439.

Hicks, M. & A. Hicks 2001. *St Gregory's Priory, Northgate, Canterbury Excavations 1988-91* The Archaeology of Canterbury. Canterbury: Canterbury Archaeological Trust Ltd.

Higgins, V. 1989. A Model for Assessing Health Patterns from Skeletal Remains. In F. L. J. B. C.A. Roberts (ed.) *Burial Archaeology Current Methods and Developments*: 175-204. British Archaeological Reports (British Series) 211.

Hill, M. & K. Tidsall 1997. *Children and Society*. London: Longman.

Hill, P. 1997. *Whithorn and St Ninian: The Excavation of a Monastic Town, 1984-91*. Stroud: Sutton Publishing for the Whithorn Trust.

Hills, C. 1979. The Archaeology of Anglo-Saxon England in the Pagan Period: A Review. *Anglo-Saxon England* 8: 297-329.

Hills, C. 1977. *The Anglo-Saxon Cemetery at Spong Hill, North Elmham, Part I: Catalogue of Cremations*. Norfolk Archaeological Unit, Norfolk Museums Service: East Anglian Archaeological Report No. 5.

Hillson, S. 2000. Dental Pathology. In M. A. Katzenberg and S. R. Saunders (eds) *Biological Anthropology of the Human Skeleton*: 249-286. Chichester: Wiley-Liss.

Hillson, S. 1996. *Dental Anthropology*. Cambridge: Cambridge University Press.

Hillson, S., C. Grigson & S. Bond 1998. Dental Defects of Congenital Syphilis. *American Journal of Physical Anthropology* 107: 25-40.

Hines, J. 2002. Lies, Damned Lies, and a *Curriculum Vitae:* Reflections on Statistics and the Populations of Early Anglo-Saxon Inhumation Cemeteries In S. Lucy and A. Reynolds (eds) *Burial in Early Medieval England and Wales*: 88-102. London: Society for Medieval Archaeology Monograph 17.

Hingorani, V. & G. Shroff 1995. Natural Sex Selection for Safe Motherhood and as a Solution for Population Control. *International Journal of Gynecology and Obstetrics* 50(2): 169-171.

Hirschman, C. 1994. Why Fertility Changes. *Annual Review of Sociology* 20: 203-233.

Hoffer, P. C. & N. E. H. Hull 1981. *Murdering Mothers: Infanticide in England and New England 1558-1803*. London: Linden Studies in Anglo-American Legal History.

Hoffman, J. M. 1979. Age Estimations from Diaphyseal Lengths: Two Months to Twelve Years. *Journal of Forensic Sciences* 24: 461-469.

Holcomb, S. M. C. & L. W. Konigsberg 1995. Statistical Study of Sexual Dimorphism in the Human Fetal Sciatic Notch. *American Journal of Physical Anthropology* 97: 113-125.

Hollis, S. 1992. *Anglo-Saxon Women and the Church: Sharing a Common Fate*. Woodbridge: Boydell Press.

Holloway, J. 2008. Charcoal Burial: A Minority Burial Rite in Early Medieval Europe. In E. M. Murphy (ed.) *Deviant Burial in the Archaeological Record*: 131-147. Oxford: Oxbow Books.

Hooper, B. 1996. A Medieval Depiction of Infant-feeding in Winchester Cathedral *Medieval Archaeology* 40: 230-233.

Hoppa, R. D. 2002. Paleodemography: Looking Back and Thinking Ahead. In R. D. Hoppa and J. W. Vaupel (eds) *Paleodemography: Age Distributions from Skeletal Samples*: 9-28. Cambridge: Cambridge University Press.

Hoppa, R. D. & C. M. Fitzgerald 1999. From Head to Toe: Integrating Studies from Bones and Teeth in Biological Anthropology. In R. D. Hoppa and C. M. Fitzgerald (eds) *Human Growth in the Past: Studies from Bones and Teeth*: 1-31. Cambridge: Cambridge University Press.

Howe, M. G. 1997. *People, Environment, Disease and Death: A Medical Geography of Britain Throughout the Ages* Cardiff: University of Wales Press.

Hoyles, M. 1979. Childhood in Historical Perspective. In M. Hoyles (ed.) *Changing Childhood*: [10],290p. London: Writers and Readers Publishing Cooperative.

Huck, P. 1995. Infant Mortality and Living Standards of English Workers During the Industrial Revolution. *The Journal of Economic History* 55(3): 528-550.

Hunt, D. R. 1990. Sex Determination in the Subadult Ilia: an Indirect Test of Weaver's Nonmetric Sexing Method. *Journal of Forensic Science* 35: 881-885.

Hunter, W. 1818. *The Uncertainty of the Signs of Murder in the Case of Bastard Children: a Lecture given to Members of the Medical Society July 14, 1783.* London: J. Callow, Crown Court; http://www.gutenberg.org/etext/26870 consulted 18/02/2010.

Hursthouse, R. 1995. *Beginning Lives*. Oxford: Blackwell Publishers Ltd.

Ivens, R. J., P. Busby & N. Shepherd 1995. *Tattenhoe and Westbury : Two Deserted Medieval Settlements in Milton Keynes* Buckinghamshire Archaeological Society Monograph Series: no.8:

Jackes, M. 1992. Paleodemography: Problems and Techniques. In S. S. A. M. Katzenberg (ed.) *Skeletal Biology of Past Peoples: Research Method*: 189-224. New York: Wiley-Liss.

Jackson, M. 2006. Historical Keyword: Infanticide. *The Lancet* 367: 809.

Jackson, M. 1996. *New-born Child Murder: Women, Illegitimacy and the Courts in Eighteenth-Century England* Manchester: Manchester University Press.

Jakobovits, I. 1978. Jewish Views on Infanticide. In M.Kohl (ed.) *Infanticide and Value of Life*: 23-31. Buffalo, New York: Prometheus Books.

Jankauskas, R. 1999. Tuberculosis in Lithuania: Paleopathological and Historical Correlations. In G. Pálfi, O. Dutour, J. Deák and I. Hutás (eds) *Tuberculosis: Past and Present*: 551–558. Szeged: Golden Book Publisher Ltd., Tuberculosis Foundation.

Jay, M. 2009. Breastfeeding and Weaning Behaviour in Archaeological Populations: Evidence from the Isotopic Analysis of Skeletal Materials. *Childhood in the Past* 2: 163-178.

Jewell, H. 1996. *Women in Medieval England*. Manchester: Manchester University Press.

Jha, P., R. Kumar, P. Vasa, N. Dhingra, D. Thiruchelvam & R. Moineddin 2006. Low Male – to – Female Sex Ratio of Children Born in India: National Survey of 1.1 Million Households. *Lancet* 367: 211–18.

Johansson, S. R. 1984. Deferred Infanticide: Excess Female Mortality During Childhood. In G. Hausfater and S. B. Hrdy (eds) *Infanticide: Comparative and Evolutionary Perspectives*: 463-485. New York: Aldine Publishing Company.

Johnson-Hanks, J. 2008. Demographic Transitions and Modernity. *Annual Review of Anthropology* 37: 301–315.

Johnston, F. E. & R. W. Mack 1985. Interobserver Reliability of Skinfold Measurements in Infants and Young Children. *American Journal of Physical Anthropology* 67: 285-289.

Jones, D. 1999. Evolutionary Psychology. *Annual Review of Anthropology* 28: 553-575.

Judd, M. A. & C. A. Roberts 1998. Fracture Patterns at the Medieval Leper Hospital in Chichester. *American Journal of Physical Anthropology* 105: 43-55.

Judson, O. P. 1994. Killing the Sex Ratio. *Nature* 372: 503-504.

Kaplan, H. 1996. A Theory of Fertility and Parental Investment in Traditional and Modern Human Societies. *Yearbook of Physical Anthropology* 39: 91 –135.

Katzenberg, M. A., D. A. Herring & S. R. Saunders 1996. Weaning and Infant Mortality: Evaluating the Skeletal Evidence. *Yearbook of Physical Anthropology* 39: 177-199.

Keenleyside, A. 1998. Skeletal Evidence of Health and Disease in Pre-Contact Alaskan Eskimos and Aleuts. *American Journal of Physical Anthropology* 107: 51-70.

Keeping, D. 2000. *Life and Death in English Nunneries: a Biocultural Study of Variations in the Health of Women during the Later Medieval Period, 1066-1540*. University of Bradford Unpublished PhD Thesis.
Kellett, R. J. 1992. Infanticide and Child Destruction: the Historical, Legal and Pathological Aspects. *Forensic Science International* 53: 1-28.
Kellum, B. A. 1974. Infanticide in England in the Later Middle Ages. In W. Langer. Infanticide: An Historical Survey. *History of Childhood Quarterly* 1(3): 367-388.
Kettle, A. J. 1995. Ruined Maids: Prostitutes and Servant Girls in Later Medieval England. In R. R. Edwards and V. Ziegler (eds) *Matrons and Marginal Women in Medieval Society*: 19-32. Woodbridge, Suffolk: The Boydell Press.
Kingsley, A. G. 1989. *The Anglo-Saxon Cemetery at Millgate, Newark-on-Trent, Nottinghamshire*. Nottingham: Nottingham Archaeological Monographs 2.
Kipp, J. 2007. *Romanticism, Maternity, and the Body Politic*. Cambridge Studies in Romanticism 57. Cambridge: Cambridge University Press.
Kirby, D., K. McWhirter, M. Teitelbaum & C. Darlington 1967. A Possible Immunological Influence on the Sex Ratio. *Lancet* 2: 139-140.
Kjølbye-Biddle, B. 1992. Dispersal or Concentration: The Disposal of the Winchester Dead over 2000 years. In S. Basset (ed.) *Death in Towns: Urban Responses to the Dying and the Dead 100-1600*: 210-247. Leicester: Leicester University Press.
Kluge, E.-H. W. 1978. Infanticide as the Murder of Persons. In M. Kohl (ed.) *Infanticide and Value of Life*: 32-45. Buffalo, New York: Prometheus Books.
Kluge, E.-H. W. 1975. *The Practice of Death*. New Haven; London: Yale University Press.
Knapp, T. R. 1992. Technical Error of Measurement: A Methodological Critique. *American Journal of Physical Anthropology* 87: 235-236.
Knocker, G. M. 1967. Excavations at Red Castle. *Norfolk Archaeology* 34: 119-186
Koenen, M. A. & J. R. Thompson 2008. Filicide: Historical Review and Prevention of Child Death by Parent. *Infant Mental Health Journal* 29(1): 61-75.
Koepke, R., J. Sobel & S. S. Arnon 2008. Global Occurrence of Infant Botulism, 1976-2006. *Pediatrics* 122: 73-82.
Kohl, M. 1974. *The Morality of Killing: Sanctity of Life, Abortion and Euthanasia*. London: Peter Owen Ltd.
Kors, A. C. & E. Peters (eds) 1973. *Witchcraft in Europe 1100-1700: A Documentary History*. London: J.M. Dent & Sons Ltd.
Kraemer, S. 2000. The Fragile Male. *British Medical Journal* 321: 1609-1612.
Krause, J. T. 1959. Some Implications of Recent Work in Historical Demography. *Comparative Studies in Society and History* 1(2): 164-188.
Krogman, W. M. & M. Y. İşcan 1986. *The Human Skeleton in Forensic Medicine* (2nd edn). Springfield Illinois: Charles C. Thomas.
Lallo, J. W. & J. C. Rose 1979. Patterns of Stress, Disease and Mortality in Two Prehistoric Populations from North America. *Journal of Human Evolution* 8: 323-335.
Lambie, I. 2001. Mothers who Kill: The Crime of Infanticide. *International Journal of Law and Psychiatry* 24: 71-80.
Lampl, M. & P. Jeanty 2003. Timing is Everything: a Reconsideration of Fetal Growth Velocity Patterns Identifies the Importance of Individual and Sex Differences. *American Journal of Human Biology* 15: 667–680.
Lampl, M. & F. E. Johnston 1996. Problems in the Ageing of Skeletal Juveniles: Perspectives from Maturation Assessments of Living Children. *American Journal of Physical Anthropology* 101: 345-355.
Landis, J. R. & G. G. Koch 1977. The Measurement of Observer Agreement for Categorical Data. *Biometrics* 33(1): 159-174.
Langer, W. L. 1974a. Infanticide: A Historical Survey. *History of Childhood Quarterly* 1(3): 353-365.

Langer, W. L. 1974b. Further Notes on the History of Infanticide. *History of Childhood Quarterly* 1: 129-134.
Langer, W. L. 1972. Checks on Population Growth: 1750-1850. *Scientific American* 226(2): 92-99.
Larsen, C. S. 1997. *Bioarchaeology: Interpreting Behaviour from the Human Skeleton*. Cambridge: Cambridge University Press.
Larsen, C. S. 1995. Biological Changes in Human Populations with Agriculture. *Annual Review of Anthropology* 24: 185-213.
Laslett, P. 1980. Introduction: Comparing Illegitimacy Over Time and Between Cultures. In P. Laslett, K. Oosterveen and R. M. Smith (eds) *Bastardy and its Comparative History : Studies in the History of Illegitimacy and Marital Nonconformism in Britain, France, Germany, Sweden, North America, Jamaica and Japan*. Studies in Social and Demographic History. London: Edward Arnold
Latham, R. E. & L. Sherley-Price (eds) 1968. *Bede: A History of the English Church and People* Penguin Books.
Leach, P. (ed.) 1984. *The Archaeology of Taunton: Excavations and Fieldwork to 1980*. Bristol: Western Archaeological Trust Excavation Monographs Vol. 8.
Lee, F. & J. Magilton 2008. Discussion. In J. Magilton, F. Lee and A. Boylston (eds) *Lepers Outside the Gate: Excavations at the Cemetery of the Hospital of St James and St Mary Magdalene, Chichester, 1986-87 and 1993*: 263-269. York: Council for British Archaeology: Chichester Excavation 10 & CBA Research Report 158.
Lee, K. A. 1994. Attitudes and Prejudices Towards Infanticide: Carthage, Rome and Today. . *Archaeological Review from Cambridge* 13(2): 65-79.
Leeds, E. T. & R. J. C. Atkinson 1944. An Anglo-Saxon Cemetery at Nassington, Northants. *The Antiquaries journal* 24: 100-128
Leeds, E. T. & D. B. Harden 1936. *The Anglo-Saxon Cemetery at Abingdon, Oxford*. Oxford: University of Oxford & Ashmolean Museum.
Lepowsky, M. 1987. Food Taboos and Child Survival: A Case Study from the Coral Sea. In N. Scheper-Hughes (ed.) *Child Survival: Anthropological Perspectives on the Treatment and Maltreatment of Children*: 71-92. Boston: D Reidel Publishing Company.
Lethbridge, T. C. 1926. The Anglo-Saxon Cemetery, Burwell, Cambs. *Proceedings of the Cambridge Antiquarian Society* 27: 72-79.
Levine, R. A. & S. C. M. Scrimshaw 1983. Effects of Culture on Fertility: Anthropological Considerations. In R. Lee and R. Bulatao (eds) *Determinants of Fertility in Developing Countries: Fertility Regulation and Institutional Influences*: 666-695. London: Academic Press.
Lewis, M. 2008. The Children. In J. Magilton, F. Lee and A. Boylston (eds) *Lepers Outside the Gate: Excavations at the Cemetery of the Hospital of St James and St Mary Magdalene, Chichester, 1986-87 and 1993*: 174-187. York: Council for British Archaeology: Chichester Excavation 10 & CBA Research Report 158.
Lewis, M. 2002a. *Urbanisation and Child Health in Medieval and Post-Medieval England. An Assessment of the Morbidity and Mortality of Non-adult Skeletons from the Cemeteries of Two Urban and Two Rural sites in England AD 850-1859*. Oxford: BAR British Series 330.
Lewis, M. 2002b. Infant and Childhood Leprosy: Present and Past. In C. A. Roberts, M. E. Lewis and K. Manchester (eds) *The Past and Present of Leprosy: Archaeological, Historical, Palaeopathological and Clinical Approaches*: 163-170. Oxford: British Archaeological Reports International Series 1054.
Lewis, M. 2000. Non Adult Palaeopathology: Current Status and Future Potential. In M. Cox and S. Mays (eds) *Human Osteology in Archaeology and Forensic Science*: 39-57. London: Greenwich Medical Media.
Lewis, M. E. 2007. *The Bioarchaeology of Children: Perspectives from Biological and Forensic Anthropology*. Cambridge: Cambridge University Press.

Lewis, M. E. 2004. Endocranial Lesions in Non-adult Skeletons: Understanding their Aetiology. *International Journal of Osteoarchaeology* 14: 82-97.

Lewis, M. E. 1999. *The Impact of Urbanisation and Industrialisation in Medieval and Post-Medieval Britain*. University of Bradford Unpublished PhD Thesis

Lewis, M. E. & R. Gowland 2007. Brief and Precarious Lives: Infant Mortality in Contrasting Sites from Medieval and Post-Medieval England (AD 850–1859). *American Journal of Physical Anthropology* 134: 117-129.

Liem, M. & F. Koenraadt 2008. Filicide: A Comparative Study of Maternal Versus Paternal Child Homicide. *Criminal Behaviour and Mental Health* 18: 166-176.

Lilley, J. M., G. Stroud, D. R. Brothwell & M. H. Williamson 1994. The Jewish Burial Ground at Jewbury. *Archaeology of York* 12/3.

Liversidge, H. 1994. Accuracy of Age Estimation from Developing Teeth of a Population of Known Age (0-5.4 years). *International Journal of Osteoarchaeology* 4: 37-45.

Liversidge, H. M. & T. Molleson 2004. Variation in Crown and Root Formation and Eruption of Human Deciduous Teeth. *American Journal of Physical Anthropology* 123: 172–180.

Loth, S. R. 1996. *Sexual Dimorphism in the Human Mandible: an Evolutionary and Developmental Perspective.* . Ph.D. thesis, University of Witwatersrand. Ann Arbor: University Microfilms, Inc.

Loth, S. R. & M. Henneberg 2001. Sexually Diamorphic Mandibular Morphology in the First Few Years of Life. *American Journal of Physical Anthropology* 115: 179-186.

Lucy, S. 2000. *The Anglo-Saxon Way of Death: Burial Rites in Early England*. Gloucestershire: Sutton Publishing

Lucy, S. 1998. *The Early Anglo-Saxon Cemeteries of East Yorkshire: An Analysis and Reinterpretation*. British Archaeological Reports British Series 272:

Lucy, S. 1994. Children in Early Medieval Cemeteries. *Archaeological Review from Cambridge* 13(2): 21-34.

Lucy, S. & A. Reynolds 2002. Burial in Early Medieval England and Wales: Past, Present and Future. In S. Lucy and A. Reynolds (eds) *Burial in Early Medieval England and Wales*: 1-14. London: Society for Medieval Archaeology Monograph 17.

Lyman, R. B. 1974. Barbarism and Religion: Late Roman and Early Medieval Childhood. In L. Demause (ed.) *The History of Childhood: The Untold History of Child Abuse*: 101-181. New York: Psychohistory Press.

Maat, G. J. R. 2004. Scurvy in Adults and Youngsters: the Dutch Experience. A Review of the History and Pathology of a Disregarded Disease. *International Journal of Osteoarchaeology* 14: 77-81.

Macfarlane, A. 1993. *Marriage and Love in England: Modes of Reproduction 1300 -1840*. Oxford: Blackwell.

Macfarlane, A. 1980. Illegitimacy and Illegitimates in Early English History. In P. Laslett, K. Oosterveen and R. M. Smith (eds) *Bastardy and its Comparative History: Studies in the History of Illegitimacy and Marital Nonconformism in Britain, France, Germany, Sweden, North America, Jamaica and Japan*: 71-93. Studies in Social and Demographic History. London: Edward Arnold

Macpherson, P. M. 2006. *Tracing Change: An Isotopic Investigation of Anglo-Saxon Childhood Diet*. University of Sheffield unpublished PhD thesis.

Magilton, J. 2008. The Cemetery. In J. Magilton, F. Lee and A. Boylston (eds) *Lepers Outside the Gate: Excavations at the Cemetery of the Hospital of St James and St Mary Magdalene, Chichester, 1986-87 and 1993*: 84-132. York: Council for British Archaeology: Chichester Excavation 10 & CBA Research Report 158.

Malgosa, A., M. P. Aluja & A. Isidro 1996. Pathological Evidence in Newborn Children from the Sixteenth Century in Huelva (Spain). *International Journal of Osteoarchaeology* 6: 388-396.

Malim, T. & J. Hines 1998. *The Anglo-Saxon Cemetery at Edix Hill (Barrington A), Cambridgeshire*. York: Council for British Archaeology Research Report 112.

Manchester, K. 2002. Infective Bone Changes in Leprosy. In C.A. Roberts, M. E. Lewis and K. Manchester (eds) *The Past and Present of Leprosy: Archaeological, Historical, Palaeopathological and Clinical Approaches*: 69-72. Oxford: British Archaeological Reports International Series 1054.

Manchester, K. 1992. The Palaeopathology of Urban Infections. In S. Bassett (ed.) *Death in Towns*: 8-14. Leicester: Leicester University Press.

Margerison, B. J. & C. J. Knüsel 2002. Paleodemographic Comparison of a Catastrophic and Attritional Death Assemblage. *American Journal of Physical Anthropology* 119: 134-143.

Marks, M. 2006. Infanticide. *Psychiatry* 5(1): 13-15.

Marks, M. N. 1996. Characteristics and Causes of Infanticide in Britain. *International Review of Psychiatry* 8: 99-106.

Marks, M. N. & R. Kumar 1993. Infanticide in England and Wales. *Medicine, Science and the Law* 33: 329-339.

Marlow, C. A. 1992a. Human Bone from 1989. In C. Scull (ed.) *Excavation and Survey at Watchfield, Oxfordshire, 1983-92*: 124-281. 149. Archaeological Journal.

Marlow, M. 1992b. The Human Remains. In S. J. Sherlock and M. G. Welch (eds) *An Anglo-Saxon Cemetery at Norton Cleveland*: 107-120. Council for British Archaeology Research Report 82.

Mattingly, H. & S. A. Handford (trans.) 1975. *Tacitius: The Agricola and the Germania*. (revised edn.). Middlesex: Penguin Books.

Maxwell-Stuart, P. G. 2007. *Malleus Maleficarum*. Manchester Manchester University Press.

May, R. L., A. H. Goodman & R. S. Meindl 1993. Response of Bone and Enamel Formation to Nutritional Supplementation and Morbidity Among Malnourished Guatemalan Children. *American Journal of Physical Anthropology* 92: 37-51.

Mays, S. 2008a. A Likely Case of Scurvy from Early Bronze Age Britain. *International Journal of Osteoarchaeology* 18: 178-187.

Mays, S. 2008b. Metabolic Bone Disease. In R. Pinhasi and S. Mays (eds) *Advances in Human Palaeopathology*: 215-251. Chichester: John Wiley & Sons, Ltd.

Mays, S. 2003a. Bone strontium: calcium ratios and duration of breastfeeding in a Medieval skeletal population. *Journal of Archaeological Science* 30: 731-741.

Mays, S. 2003b. Comment on ‘A Bayesian Approach to Ageing Perinatal Skeletal Material from Archaeological Sites: Implications for the Evidence for Infanticide in Roman Britain’ by R.L. Gowland and A.T. Chamberlain. *Journal of Archaeological Science* 30: 1695-1700.

Mays, S. 2000. The Archaeology and History of Infanticide, and its Occurrence in Earlier Populations. In J. S. Derevenski (ed.) *Children and Material Culture* London Routledge.

Mays, S. 1998. *The Archaeology of Human Bones*. London: Routledge.

Mays, S. 1996. The Human Skeletal Remains. In J. R. Timby (ed.) *The Anglo-Saxon Cemetery at Empingham II, Rutland: Excavations carried out between 1974 and 1975*: 21-33. Oxford: Oxbow Monograph 70.

Mays, S. 1995. Child Killing Through the Ages. *British Archaeology* 2: 8–9.

Mays, S. 1993. Infanticide in Roman Britain. *Antiquity* 67: 883-8.

Mays, S. 1985. The Relationship between Harris Line Formation and Bone Growth and Development. *Journal of Archaeological Science* 12: 207-220.

Mays, S. & M. Faerman 2001. Sex Identification in Some Putative Infanticide Victims from Roman Britain Using Ancient DNA. *Journal of Archaeological Science* 28: 555–559.

McCormick, M. C. 1985. The Contribution of Low Birth Weight to Infant Mortality and Childhood Morbidity. *New England Journal of Medicine* 312 (2): 82–90.

McCormick, R. A. 1974. To Save or Let Die: The Dilemma of Modern Medicine. *Journal of the American Medical Association* 229(2): 172-176.

McDermaid, G. & E. G. Winkler 1955. Psychopathology of Infanticide. *Journal of Clinical and Experimental Psychopathology* 16(1): 22-41.

McGovern, C. H. 2003. *Evidence for Infanticide in Anglo-Saxon Communities?* University of Bradford Unpublished MSc Dissertation.

McIntyre, M. H. & C. P. Edwards 2009. The Early Development of Gender Differences. *Annual Review of Anthropology* 38: 83–97.

McKee, L. 1984. Sex Differentials in Survivorship and the Customary Treatment of Infants and Children. *Medical Anthropology* 8: 91-108.

McKenna, J. J., H. L. Ball & L. T. Gettler 2007. Mother–Infant Cosleeping, Breastfeeding and Sudden Infant Death Syndrome: What Biological Anthropology Has Discovered About Normal Infant Sleep and Pediatric Sleep Medicine. *Yearbook of Physical Anthropology* 50: 133-161.

McKinley, J. I. 2006. Cremation...the Cheap Option? In R. Gowland and C. Knüsel (eds) *Social Archaeology of Funerary Remains*: 81-88. Oxford: Oxbow.

McKinley, J. I. 2005. The Cremated Humans. In V. Birbeck (ed.) *The Origins of Mid-Saxon Southampton. Excavations at the Friends Provident St Mary's Stadium 1998-2000*. Salisbury: Wessex Archaeology

McKinley, J. I. 1994a. *The Anglo-Saxon Cemetery at Spong Hill, North Elmham, Part VIII: The Cremations*. East Anglian Archaeology Report 69. : Norfolk Archaeological Unit, Norfolk Museums Service.

McKinley, J. I. 1994b. A Pyre and Grave Goods in British Cremation Burials; Have we Missed Something? *Antiquity* 68: 132-134.

McKinley, J. I. 1989. Spong Hill Anglo-Saxon Cremation Cemetery. In C. A. Roberts, F. Lee and J. Bintliff (eds) *Burial Archaeology Current Research, Methods and Developments*: 241-8. British Archaeological Reports British Series 211.

McLaren, A. 1990. *A History of Contraception from Antiquity to the Present Day*. Oxford: Basil Blackwell Ltd.

McLaren, D. 1979. Nature's Contraceptive. Wet Nursing and Prolonged Lactation: The Case of Chesham, Buckinghamshire, 1578-1601. *Medical History* 23: 426-441.

McLaren, D. 1978. Fertility, Infant Mortality and Breast Feeding in the Seventeenth Century. *Medical History* 22: 380-381.

McLaughlin, M. M. 1974. Survivors and Surrogates: Children and Parents from the Ninth to the Thirteenth Centuries. In L. Demause (ed.) *The History of Childhood: The Untold History of Child Abuse*: 101-181. New York: Psychohistory Press.

McMahan, J. 2002. *The Ethics of Killing: Problems at the Margins of Life*. Oxford: Oxford University Press.

McMillen, M. 1979. Differential Mortality by Sex in Fetal and Neonatal Deaths. *Science* 204: 89-91.

McNamara, J. A. 1987. Matres Patriae / Matres Eccesiae: Women of the Roman Empire. In R. Bridenthal, C. Koonz and S. Stuard (eds) *Becoming Visible: Women in European History*: 107-129. (2nd edn.) Boston: Houghton Mifflin Company.

McNamara, J. A. & S. Wemple 1988. The Power of Women Through the Family in Medieval Europe, 500-1100. In M. Erler and M. Kowaleski (eds) *Women and Power in the Middle Ages*. London: The University of Georgia Press.

McNeil, J. T. & H. M. Gamer 1938. *Medieval Handbooks of Penance*. New York: Columbia University Press.

Meaney, A. 1964. *A Gazetteer of Early Anglo-Saxon Burial Sites*. London: Allen& Unwin.

Meaney, A. L., & S.C. Hawkes 1970. *Two Anglo-Saxon cemeteries at Winnall, Winchester, Hampshire*. London: Society for Medieval Archaeology Monograph Series No 4.

Meens, R. 1994. Children and Confession in the Early Middle Ages. In D. Wood (ed.) *The Church and Childhood: Papers Read at the 1993 Summer Meeting and the 1994 Winter Meeting of the Ecclesiastical History Society*: 53-65. Oxford: Ecclesiastical History Society by Blackwell Publishers.

Meindl, R. S. & K. F. Russell 1998. Recent Advances in Method and Theory in Paleodemography. *Annual Review of Anthropology* 27: 375-399.
Millard, A. 2001. The Deterioration of Bone. In D. R. Brothwell and A. M. Pollard (eds) *Handbook of Archaeological Sciences*: 637-647. Chichester: John Wiley & Sons Ltd.
Miller, B. D. 1987. Female Infanticide and Child Neglect in Rural North India. In N. Scheper-Hughes (ed.) *Child Survival: Anthropological Perspectives on the Treatment and Maltreatment of Children*: 95-112. Boston: D Reidel Publishing Company.
Miller, P. & D. Saxby 2007. *The Augustinian Priory of St Mary Merton, Surrey: Excavations 1976-90*. London: MoLAS Monograph 34.
Moggi-Cecchi, J., E. Pacciani & J. Pinto-Cisternas 1994. Enamel Hypoplasia and Age at Weaning in 19th-Century Florence, Italy. *American Journal of Physical Anthropology* 93: 299-306.
Møller-Christensen, V. 1967. Evidence of Leprosy in Earlier Peoples. In D. R. Brothwell and A. T. Sandison (eds) *Diseases in Antiquity. A Survey of the Diseases, Injuries and Surgery of Early Populations*: 295-306. Springfield: Charles C. Thomas.
Molleson, T. 2003. The Archaeology of Family Planning and the Role of Infanticide. *Archaeological Review from Cambridge* 16(2): 117-127.
Molleson, T. 1991. Demographic Implications of the Age Structure of Early English Cemetery Samples. *Actes des Journees Anthropologiques* 5: 113-121.
Molleson, T., K. Cruse & S. Mays 1998. Some Sexually Dimorphic Features of the Human Juvenile Skull and their Value in Sex Determination in Immature Skeletal Remains. *Journal of Archaeological Science* 25: 719-728.
Molleson, T. I. 1989. Social Implications of Mortality Patterns of Juveniles from Poundbury Camp, Romano-British Cemetery. *Anthropologischer Anzeiger* 47: 27-38.
Montague, P. 1989. Infant Rights and the Morality of Infanticide. *Nous* 23: 63-81.
Moorrees, C. F. A., E. A. Fanning & E. E. Hunt 1963a. Age Formation by Stages for Ten Permanent Teeth. *Journal of Dental Research* 42: 1490-1502.
Moorrees, C. F. A., E. A. Fanning & E. E. Hunt 1963b. Formation and Resorption of Three Deciduous Teeth in Children. *American Journal of Physical Anthropology* 21: 205-213.
Morton, A. D. (ed.) 1992. *Excavations at Hamwic Volume 1: Excavations 1946-83, Excluding Six Dials and Melbourne Street* CBA Research Reports
Morton, R. J. & W. D. Lord 2006. Taphonomy of Child-Sized Remains: A Study of Scattering and Scavenging in Virginia, USA. *Journal of Forensic Science* 51(3): 475-479.
Mosher Stuard, S. 1984. The Sociobiological Model and the Medieval Evidence. *American Anthropologist, New Series* 86(2): 410-413.
Mull, D. S. & J. D. Mull 1987. Infanticide Among the Tarahumara of the Mexican Sierra Madre. In N. Scheper-Hughes (ed.) *Child Survival: Anthropological Perspectives on the Treatment and Maltreatment of Children*: 113-132. Boston: D Reidel Publishing Company.
Murray, J. & T. Macdonald 2005. Excavations at Station Road, Gamlingay, Cambridgeshire *Anglo-Saxon Studies in Archaeology and History* 13: 173-330.
Myrc, J. 1902. *Instructions for Parish Priests*. London: Early English Text Society.
Myres, J. N. L. & B. Green 1973. *The Anglo-Saxon Cemeteries of Caistor-by-Norwich and Markshall, Norfolk*. London: Society of Antiquaries of London, Distributed by Thames and Hudson.
Mytum, H. 1994. Parish and People: Excavations at Kellington Church. *Medieval Life* 1: 19-22.
Naeye, R., L. Burt, D. Wright, W. Blanc & D. Tatter 1971. Neonatal Mortality: The Male Disadvantage. *Pediatrics* 48(6): 902-906.
Naeye, R. L. & L. M. Demers 1987. Differing Effects of Fetal Sex on Pregnancy and its Outcome. *American Journal of Medical Genetics* 28 (S3): 67-74.
Neel, J. V. 1970. Lessons from a Primitive People. *Science* 170(3960): 815-822.
Neiburger, E. J. 1990. Enamel Hypoplasias: Poor Indicators of Dietary Stress. *American Journal of Physical Anthropology* 82: 231-233.

Nelson, J. L. 1994. Parents, Children, and the Church in the Earlier Middle Ages. In D. Wood (ed.) *The Church and Childhood: Papers Read at the 1993 Summer Meeting and the 1994 Winter Meeting of the Ecclesiastical History Society*: 81-114. Oxford: Ecclesiastical History Society by Blackwell Publishers.

Nevas, M., M. Lindström, K. Hautamäki, S. Puoskari & H. Korkeala 2005. Prevalence and Diversity of Clostridium botulinum Types A, B, E and F in Honey Produced in the Nordic Countries. *International Journal of Food Microbiology* 105(2): 145-151.

Nordborg, M. 1992. Female Infanticide and Human Sex Ratio Evolution. *Journal of Theoretical Biology* 158: 195–198.

O'Connor, T. P. 1993. The Human Skeletal Material. In W. J. Rodwell and K. A. Rodwell (eds) *Rivenhall: Investigations of a Villa, Church and Village, 1950-1977: Volume 2 Specialist Studies and Index to Volumes 1 and 2* 96-102. Council for British Archaeology Research Report: 80

O'Shea, J. M. Z. 1984. Oleneostrovski Mogilnik: Reconstructing the Social and Economic Organisation of Prehistoric Foragers in Northern Russia. *Journal of Anthropological Archaeology* 3: 1-40.

Oakey, N. & P. Spoerry 1996. Excavations at Orchard Lane, Huntingdon, 1994. *Proceedings of the Cambridge Antiquarian Society* 85: 123-58

Ogden, A. 2008. Advances in the Palaeopathology of Teeth and Jaws. In R. Pinhasi and S. Mays (eds) *Advances in Human Palaeopathology*: 283-307. Chichester: John Wiley & Sons, Ltd.

Ogden, A. R., R. Pinhasi & W. J. White 2007. Gross Enamel Hypoplasia in Molars From Subadults in a 16th–18th Century London Graveyard. *American Journal of Physical Anthropology* 133: 957–966

Oliverio, A. F. 1994. Infanticide in Western Cultures: A Historic Overview. In S. Parmigiani and F. S. v. Saal (eds) *Infanticide and Parental Care: Proceedings of a Workshop Held at the International School of Ethology, Ettore Majorana Centre for Scientific Culture, Italy, 13-20 June 1990*: 105-120. Reading: Harwood Academic.

Oomman, N. & B. R. Ganatra 2002. Sex Selection: The Systematic Elimination of Girls. *Reproductive Health Matters* 10(19): 184-197.

Ortner, D. 2008. Differential Diagnosis of Skeletal Lesions in Infectious Disease. In R. Pinhasi and S. Mays (eds) *Advances in Human Palaeopathology*: 192-214. Chichester: John Wiley & Sons, Ltd.

Ortner, D. 2002. Observations on the Pathogenesis of Skeletal Disease in Leprosy. In C. A. Roberts, M. E. Lewis and K. Manchester (eds) *The Past and Present of Leprosy: Archaeological, Historical, Palaeopathological and Clinical Approaches*: 73-80. Oxford: British Archaeological Reports International Series 1054.

Ortner, D. & M. F. Ericksen 1997. Bone Changes in the Human Skull Probably Resulting from Scurvy in Infancy and Childhood. *International Journal of Osteoarchaeology* 7: 212-220.

Ortner, D. & S. Mays 1998. Dry-bone Manifestations of Rickets in Infancy and Early Childhood. *International Journal of Osteoarchaeology* 8: 45-55.

Ortner, D. J. 1998. Male-Female Immune Reactivity and its Implications for Interpreting Evidence in Human Skeletal Pathology. In A. L. Grauer and P. Stuart-Macadam (eds) *Sex and Gender in Palaeopathological Perspective*. Cambridge: Cambridge University Press.

Ortner, D. J. 1992. Skeletal Palaeopathology: Probabilities, Possibilities and Impossibilities. In J. W. Verano and D. H. Ubelaker (eds) *Disease and Demography in the Americas*: 5-13. London: Smithsonian Institution Press.

Ortner, D. J., K. Manchester & F. Lee 1991. Metastatic Carcinoma in a Leper Skeleton from a Medieval Cemetery in Chichester, England. *International Journal of Osteoarchaeology* 1: 91-98.

Page, R. I. 1970. *Life in Anglo-Saxon England*. London: B.T. Batsford Ltd.

Paine, R. R. & J. L. Boldsen 2002. Linking Age-at-Death Distributions and Ancient Population Dynamics: a Case Study. In R. D. Hoppa and J. W. Vaupel (eds) *Paleodemography: Age Distributions from Skeletal Samples*: 169-180. Cambridge: Cambridge University Press.

Pakrasi, K. 1970. *Female Infanticide in India*. Calcutta: Edition Indian.

Palubeckaitè, Z., R. Jankauskas & J. Boldsen 2002. Enamel Hypoplasia in Danish and Lithuanian Late Medieval/Early Modern Samples: a Possible Reflection of Child Morbidity and Mortality Patterns. *International Journal of Osteoarchaeology* 12: 189:201.

Parfitt, K. 2001. An Early Excavation Plan of Stonar Church Near Sandwich Kent. *Kent Archaeological Review* 145: 95-99.

Parfitt, K. 1995. The Buckland Saxon Cemetery. *Current Archaeology* 144: 459-64.

Parker-Pearson, M. 2002. *The Archaeology of Death and Burial*. Gloucester: Sutton.

Parkhouse, J., R. Roseff, J. Short, S. Ensor & M. Farley 1996. A Late Saxon Cemetery at Milton Keynes Village. *Records of Buckinghamshire* 38 199-221.

Paster, G. K. 1993. *The Body Embarrassed: Drama and the Disciplines of Shame in Early Modern England*. Ithaca, N.Y.: Cornell University Press.

Patrick, P. 2006. Approaches to Violent Death: A Case Study from Early Medieval Cambridge. *International Journal of Osteoarchaeology* 16: 347–354.

Pfau, R. O. & P. W. Sciulli 1994. A Method for Establishing the Age of Subadults. *Journal of Forensic Sciences* 39: 165-76.

Phenice, T. W. 1969. A Newly Developed Visual Method of Sexing the Os Pubis. *American Journal of Physical Anthropology* 30: 297-302.

Piers, M. W. 1978. *Infanticide*. New York: W.W. Norton & Company Inc.

Pinchbeck, I. 1954. Social Attitudes to the Problem of Illegitimacy. *The British Journal of Sociology* 5(4): 309-323.

Pinhasi, R. & C. Bourbou 2008. How Representative Are Human Skeletal Assemblages for Population Analysis? In R. Pinhasi and S. Mays (eds) *Advances in Human Palaeopathology*: 31-44. Chichester: John Wiley & Sons, Ltd.

Pollock, L. A. 1993. *Forgotten Children: Parent-Child Relations from 1500 to 1900*. Cambridge: Cambridge University Press.

Popkin, S. 1980. The Rational Peasant: The Political Economy of Peasant Society. *Theory and Society* 8(2): 411-471.

Powell, F. 1996. The Human Remains. In A. Boddington (ed.) *Raunds Furnells: The Anglo- Saxon Church and Churchyard*: 113-124. London: English Heritage.

Power, E. 1922. *Medieval English Nunneries, 1275 to 1535*. Cambridge: Cambridge University Press.

Power, R. K. 2007. *Differential Child and Infant Mortality and Morbidity in Late Anglo-Saxon England (10th-12th Centuries AD)*. University of Bradford Unpublished MSc Dissertation.

Powicke, F. M. & C. R. Cheney 1964. *Councils & Synods, with Other Documents Relating to the English Church. Vol.2, A.D. 1205-1313*. Oxford: Clarendon Press.

Prout, A. & A. James 1990. A New Paradigm for the Sociology of Childhood? Provenance, Promise and Problems. In A. James and A. Prout (eds) *Constructing and Reconstructing Childhood: Contemporary Issues in the Sociological Study of Childhood* 7-33. 2. London: Falmer Press.

Pryor, F. 2006. *Britain in the Middle Ages: An Archaeological History*. London: Harper Collins

Qualmann, K. 1986. Winchester - Nunnaminster. *Current Archaeology* 102: 204-207.

Radin, M. 1925. The Exposure of Infants in Roman Law and Practice. *The Classical Journal*: 337-343.

Rahman, M. & J. D. Vanzon 1993. Gender Preference and Birth Spacing in Matlab, Bangladesh. *Demography* 30: 315-332.

Rahtz, P. 1969. Upton, Gloucestershire, 1964-1968. *Transactions of the Bristol and Gloucestershire Archaeological Society* 88: 74-125.

Rahtz, P., S.Hirst & S. M. Wright 2000. *Cannington Cemetery: Excavations 1962-3 of Prehistoric, Roman, Post-Roman and Later Features at Cannington Park Quarry, Near Bridgwater Somerset*. London: Society for the Promotion of Roman Studies. Britannia Monograph Series No 17.

Raley, S. & S. Bianchi 2006. Sons, Daughters, and Family Processes: Does Gender of Children Matter? *Annual Review of Sociology* 32: 401-421.

Rasmuson, M. 1971. Men, The Weaker Sex? *Impact of Science on Society Impact of Science on Society* 21(1): 43-54.

Rawson, B. 1991. Adult-Child Relationships in Roman Society. In B. Rawson (ed.) *Marriage, Divorce, and Children in Ancient Rome*: 7-30. Oxford: Clarendon Press.

Razi, Z. 1980. *Life, Marriage and Death in a Medieval Parish: Economy, Society and Demography in Halewsowen 1270-1400*. Cambridge: Cambridge University Press.

Read, D. W. & S. A. LeBlanc 2003. Population Growth, Carrying Capacity, and Conflict. *Current Anthropology* 44(1): 59-85.

Redfern, R. 2003. Sex and the City: A Biocultural Investigation into Female Health in Roman Britain. In G. Carr, E. Swift and J. Weekes (eds) *TRAC 2002 Proceedings of the Twelfth Annual Theoretical Roman Archaeology Conference*: 147-170. Oxford: Oxbow Books.

Redfield, A. 1970. A New Aid to Ageing Immature Skeletons: Development of the Occipital Bone. *American Journal of Physical Anthropology* 33: 207-220.

Retal-Laurentin, A. & D. Benoit 1976. Infant Mortality and Birth Intervals. *Population Studies* 30(2): 279-293.

Reynolds, E. L. 1945. The Bony Pelvic Girdle in Early Infancy. *American Journal of Physical Anthropology* 3: 321-354.

Richardson, A. 2005. *The Anglo-Saxon Cemeteries of Kent. Vol. 1*. British Archaeological Reports British Series 391:

Riches, D. 1974. The Netsilik Eskimo: A Special Case of Selective Female Infanticide. *Ethnology* 13: 351-361.

Roberts, C. 2002. Tuberculosis: a Multidisciplinary Approach to Past and Current Concepts, Causes and Treatment of this Infectious Disease. In P. A. Baker and G. Carr (eds) *Practitioners, Practices and Patients: New Approaches to Medical Archaeology and Anthropology. Proceedings of a conference held at Magdalene College Cambridge November 2000*: 30-45. Oxford: Oxbow Books.

Roberts, C. 2000. Infectious Disease in Biocultural Perspective: Past, Present and Future Work in Britain. In M. C. S. Mays (ed.) *Human Osteology in Archaeology and Forensic Science*: 145-162. London: Greenwich Medical Media.

Roberts, C. & M. Cox 2003. *Health and Disease in Britain: from Prehistory to the Present Day*. Stroud: Sutton Publishing.

Roberts, C. & K. Manchester 2005. *The Archaeology of Disease* (3rd edn). Stroud: Sutton Publishing.

Rodwell, W. 2001. *Wells Cathedral: Excavations and Structural Studies, 1978-93*. English Heritage Archaeological Report 21:

Rogers, J. 1999. *Burials: The Human Skeletons*. In C. Heighway and R. Bryant (eds) The Golden Minster: The Anglo-Saxon Minster and Later Medieval Priory of St Oswald at Gloucester: 229-246. London: Council for British Archaeology Research Report 117.

Rogers, T. L. 2009. Sex Determination of Adolescent Skeletons Using the Distal Humerus. *American Journal of Physical Anthropology* 140: 143-148.

Rogerson, A. & S. J. Ashley 1987. The Parish Churches of Barton Bendish: The Excavation of All Saints' and the Architecture of St Andrew's and St Mary's. In A. Rogerson, S. J. Ashley, P. Williams and A. Harris (eds): 1-45. East Anglian Archaeology Reports 32.

Rose, J. C., K. W. Condon & A. H. Goodman 1985. Diet and Dentition: Developmental Disturbances. In R. I. Gilbert and J. H. Mielke (eds) *The Analysis of Prehistoric Diets*: 281-305. London: Academic Press Inc.

Rösing, F. W. 1983. Sexing Immature Human Skeletons. *Journal of Human Evolution* 12: 149-155.
Roth, E. A. 1992. Applications of Demographic Models to Paleodemography. In S. S. A. M. Katzenberg (ed.) *Skeletal Biology of Past Peoples: Research Method*: 175-188. New York: Wiley-Liss.
Rothschild, B. M. & C. Rothschild 1997. Congenital Syphilis in the Archaeological Record: Diagnostic Insensitivity of Osseous Lesions. *International Journal of Osteoarchaeology* 7: 39-42.
Russell, J. C. 1948. *British Medieval Population*. Albuquerque: The University of New Mexico Press.
Russell, J. C. 1937. Medieval Population. *Social Forces* 15(4): 503-511.
Ryan, A. S. 1997. Iron-Deficiency Anaemia in Infant Development: Implications for Growth, Cognitive Development, Resistance to Infection, and Iron Supplementation. *Yearbook of Physical Anthropology* 40: 25-62.
Saller, R. P. 1984. Roman Dowry and the Devolution of Property in the Principate. *Classical Quarterly* 34: 195-205.
Sanders, J. L. & S. B. Morgan 1997. Family Stress and Adjustments as Percieved by Parents of Children with Autism or Down Syndrome: Implications for Intervention. *Child and Family Behaviour Therapy* 19(4): 15-32.
Sauer, R. 1978. Infanticide and Abortion in Nineteenth-Century Britain. *Population Studies* 32(1): 81-93.
Saul, F. P. & J. M. Saul 1989. Osteobiology: A Maya Example. In M. Y. Işcan and K. A. R. Kennedy (eds) *Reconstruction of Life from the Skeleton*: 287-302. New York: Alan R. Liss Inc.
Saunders, S. 1992. Subadult Skeletons and Growth Related Studies. In S. S. A. M. Katzenburg (ed.) *Skeletal Biology of Past Peoples: Research Methods*: 1-20. New York: Wiley-Liss.
Saunders, S., C. DeVito, A. Herring, R. Southern & R. Hoppa 1993. Accuracy Tests of Tooth Formation Age Estimations for Human Skeletal Remains. *American Journal of Physical Anthropology* 92: 173-188.
Saunders, S. & R. D. Hoppa 1993. Growth Deficit in Survivors and Non-Survivors: Biological Mortality Bias in Subadult Skeletal Samples. *Yearbook of Physical Anthropology* 36: 127-151.
Saunders, S. R. & L. Barrans 1999. What can be done about the Infant Category in Skeletal Samples? In R. D. Hoppa and C. M. Fitzgerald (eds) *Human Growth in the Past: Studies from Bones and Teeth*: 183-209. Cambridge: Cambridge University Press.
Saunders, S. R. & D. Yang 1999. Sex Determination: XX or XY from the Human Skeleton. In S. I. Fairgrieve (ed.) *Forensic Osteological Analysis: A Book of Case Studies*: 36-59. Springfield Illinois: Charles C. Thomas.
Schaffer, H. R. 1971. *The Growth of Sociability*. Middlesex: Penguin Books Ltd.
Scheper-Hughes, N. 1987. The Cultural Politics of Child Survival. In N. Scheper-Hughes (ed.) *Child Survival: Anthropological Perspectives on the Treatment and Maltreatment of Children*: 1–29. Boston: D Reidel Publishing Company.
Scheuer, J. L. & S. M. MacLaughlin-Black 1994. Age Estimation from the Pars Basilaris of the Fetal and Juvenile Occipital Bone. *International Journal of Osteoarchaeology* 4: 377-380.
Scheuer, J. L., J. H. Musgrave & S. P. Evans 1980. Estimation of Perinatal and Late Foetal Age from Limb Bone Length by Linear and Logarithmic Regression. *Annals of Human Biology* 7: 257–265.
Scheuer, L. 2002. Brief Communication: A Blind Test of Mandibular Morphology for Sexing Mandibles in the First Few Years of Life. *American Journal of Physical Anthropology* 119: 189-191.
Scheuer, L. & S. Black 2004. *The Juvenile Skeleton*. London: Elsevier Academic Press.
Scheuer, L. & S. Black 2000. Development and Ageing of Juvenile Skeletons. In M. Cox and S. Mays (eds) *Human Osteology in Archaeology and Forensic Science*: 9-21. London: Greenwich Medical Media.

Schofield, J. 1988. The Cemetery of St Nicholas Shambles. In W. White (ed.) *Skeletal Remains from the Cemetery of St Nicholas Shambles, City of London*: 7-27. London: London and Middlesex Archaeological Society Special Paper No. 9.

Schultz, M. 2001. Paleohistopathology of Bone: A New Approach to the Study of Ancient Diseases. *American Journal of Physical Anthropology* 44: 106–147.

Schurr, M. R. 1998. Using Stable Nitrogen-Isotopes to Study Weaning Behavior in Past Populations. *World Archaeology* 30(2): 327-342.

Schurr, M. R. & M. L. Powell 2005. The Role of Changing Childhood Diets in the Prehistoric Evolution of Food Production: An Isotopic Assessment. *American Journal of Physical Anthropology* 126.

Schutkowski, H. 2006. *Human Ecology: Biocultural Adaptations in Human Communities*. Berlin Springer-Verlag.

Schutkowski, H. 1993. Sex Determination of Infant and Juvenile Skeletons: I. Morphognostic Features. *American Journal of Physical Anthropology* 90: 199-205.

Schutkowski, H. 1990. *Zur Geschlechtsdiagnose von Kinderskeletten. Morphognostische, Metrische und Diskriminanzanalytische Uuntersuchungen*. Doctoral Dissertation: University of Goettingen.

Schutkowski, H. 1987. Sex Determination of Fetal and Neonate Skeletons by Means of Discriminant Analysis. *International Journal of Anthropology* 2: 347-352.

Schwartz, L. L. & N. K. Isser 2001. Neonatalcide an Appropriate Application for Theraputic Jurisprudence? *Behavioural Sciences and the Law* 19: 703-718.

Scobie, G. & K. Qualmann 1993. *Nunnaminster. A Saxon and Medieval Community of Nuns*. Winchester: Winchester Museums Service.

Scott, E. 2001a. Unpicking a Myth: the Infanticide of Female and Disabled Infants in Antiquity. In A. G. K. L. G. Davies (ed.) *TRAC 2000. Proceedings of the Tenth Annual Theoretical Roman Archaeology Conference*: 143-151. Oxford: Oxbow Books.

Scott, E. 2001b. Killing the Female? A Review of Archaeological Narratives of Infanticide. In B. A. N.L.Wicker (ed.) *Gender and the Archaeology of Death*: 3-21. Oxford: AltaMira Press.

Scott, E. 1999. *The Archaeology of Infancy and Infant Death*. British Archaeological Reports, International Series: 819.

Scott, E. 1992. Images and Contexts of Infants and Infant Burials: Some Thoughts on some Cross-cultural Evidence. *Archaeological Review from Cambridge* 11(1): 77-92.

Scott, E. 1991. Animal and Infant Burials in Romano-British Villas: A Revitalisation Movement. In P. Garwood, D. Jennings, R. Skeates and J. Toms (eds) *Sacred and Profane: Proceedings of a Conference on Archaeology, Ritual and Religion*: Monograph 32: 115-121. Oxford: Oxford University Committee for Archaeology.

Scott , I. R. 1996. *Romsey Abbey: Report on the Excavations 1973-1991* Hampshire Field Club Monograph No.8. Stroud: Sutton Publishing for the Hampshire Field Club and Archaeological Society and Test Valley Archaeological Trust

Scott, S. & C. J. Duncan 1999. Malnutrition, pregnancy and infant mortality: a biometric model. *Journal of Interdisciplinary History* 30: 37–60.

Scrimshaw, S. C. M. 1984. Infanticide in Human Populations: Societal and Individual Concerns. In G. H. S. B. Hrdy (ed.) *Infanticide: Comparative and Evolutionary Perspectives*: 439-462. New York: Aldine Publishing Company.

Scrimshaw, S. C. M. 1983. Infanticide as Deliberate Fertility Regulation. In R. L. R. Bulatao (ed.) *Determinants of Fertility in Developing Countries: Fertility Regulation and Institutional Influences*: 245-266. London: Academic Press.

Scrimshaw, S. C. M. 1978. Infant Mortality and Behaviour in the Regulation of Family Size. *Population and Development Review* 4: 383-403.

Sellen, D. W. 2007. Evolution of Infant and Young Child Feeding: Implications for Contemporary Public Health. *Annual Review of Nutrition* 27: 123-148.

Shahar, S. 1990. *Childhood in the Middle Ages*. London: Routledge.

Shears, R. 2008. The Two Villages Where Mothers Killed Every Baby Born a Boy for Ten Years. The Daily Mail Published 28th November. *http://www.dailymail.co.uk/news/worldnews/article-1090131/The-villages-mothers-killed-EVERY-baby-born-boy-years.html#ixzz0V4EurWlJ* (consulted 26/11/2009).

Sherwood, R. J., R. S. Meindl, H. B. Robinson & R. L. May 2000. Fetal Age: Methods of Estimation and Effects of Pathology. *American Journal of Physical Anthropology* 113: 305-315.

Shoesmith, R. 1980. *Hereford City Excavations 1: Excavations at Castle Green*. Council for British Archaeology Research Report 36.

Siegel, S. 1956. *Nonparametric Statistics for the Behavioural Sciences*. London: McGraw-Hill.

Sim, J. & C. C. Wright 2005. The Kappa Statistic in Reliability Studies: Use, Interpretation, and Sample Size Requirements. *Physical Therapy* 85(3): 257-268.

Sinclair, J. A. 1962. *Aristotle: The Politics*. Middlesex: Penguin Books Ltd.

Sloane, B. & G. Malcolm 2004. Excavations at the Priory of the Order of the Hospital of St John of Jerusalem, Clerkenwell. In. London: MoLAS Monograph Service 20.

Smith, B. H. 1991. Standards of Tooth Formation and Dental Age Assessment. In M. A. Kelley and C. S. Larsen (eds) *Advances in Dental Anthropology*: 143-168. New York: Wiley-Liss.

Smith, P. & G. Avishai 2005. The Use of Dental Criteria for Estimating Postnatal Survival in Skeletal Remains of Infants. *Journal of Archaeological Science* 32: 83-89.

Sofaer Derevenski, J. 1997. Age and Gender at the Site of Tiszabolgar-Basatanya, Hungary. *Antiquity* 71: 878-889.

Sofaer Derevenski, J. 1994. Where are the Children? Accessing Children in the Past. *Archaeological Review from Cambridge* 13(2): 1-20.

Spence, T. F. & W. J. Moore 1969. The Infant Burial In P. Rahtz, Upton, Gloucestershire, 1964-1968. *Transactions of the Bristol and Gloucestershire Archaeological Society* 88: 74-125.

Stager, L. E. 1991. Eroticism and Infanticide at Ashkelon. *Biblical Archaeological Review* 17: 34-53.

Staniforth, M. 1968. *Early Christian Writings : The Apostolic Fathers*. Middlesex: Penguin Books.

Stannard, D. E. 1991. Recounting the Fables of Savagery: Native Infanticide and the Functions of Political Myth. *Journal of American Studies* 25(03): 381-417.

Steele, B. F. 1978. Psychology of Infanticide Resulting from Maltreatment. In M. Kohl (ed.) *Infanticide and the Value of Life*: 76-85. Buffalo, New York: Prometheus Books.

Steele, D. G. & C. A. Bramblett 1988. *The Anatomy and Biology of the Human Skeleton*. Texas: Texas A&M University Press.

Steele, R. 2010. *Medieval Lore from Bartholomew Anglicus*. Bibliobazar.

Stenton, D. M. 1937. *Rolls of the Justices in Eyre: being the Rolls of Pleas and Assiezes for Yorkshire in 3 Henry III (1218-19)*. London: Bernard Quaritch. The Sheldon Society.

Stewart, E. A. 2001. *Exploring Twins: Towards a Social Analysis of Twinship*. Palgrave Macmillan Ltd.

Stini, W. A. 1985. Growth Rates and Sexual Dimorphism in Evolutionary Perspective. In R. I. Gilbert and J. H. Mielke (eds) *The Analysis of Prehistoric Diets*: 191-226. London: Academic Press Inc.

Stirland, A. 1985. The Human Bones. In B. Ayres (ed.) *Excavations Within the North-East Bailey of Norwich Castle*: 47-62. Norfolk Archaeology Unit, Norfolk Museums Service: East Anglian Archaeology Report 28.

Stone, L. 1977. *The Family, Sex and Marriage in England, 1500-1800*. London: Weidenfeld and Nicolson.

Stone, L. 1966. Social Mobility in England, 1500-1700. *Past & Present* 33 16-55.

Stone, R. & N. Appleton-Fox 1996. *A View From Hereford's Past: A Report on the Excavation of Hereford's Cathedral Close in 1993*. Little Logaston, Herefordshire: Logaston Press.

Stones, J. A. 1989. The Burials at Aberdeen, Linlithgow and Perth Friaries. In *Three Scottish Carmelite Friaries: Aberdeen, Linlithgow and Perth*: 111-118. Society Of Antiquaries Of Scotland Edinburgh: Monograph Series Number 6.

Stoodley, N. 2002. Multiple Burials, Multiple Meanings? Interpreting the Early Anglo-Saxon Multiple Interment. In S. Lucy and A. Reynolds (eds) *Burial in Early Medieval England and Wales*: 103-121. London: Society for Medieval Archaeology Monograph 17.

Stoodley, N. 2000. From the Cradle to the Grave: Age Organization and the Early Anglo-Saxon Burial Rite. *World Archaeology* 31(3): 456-472.

Stoodley, N. 1999. *The Spindle and the Spear: A Critical Enquiry into the Construction and Meaning of Gender in the Early Anglo-Saxon Burial Rite*. British Archaeological Reports British Series 288.

Stroud, G. 1994. Demography and Variation In J. M. Lilley, G. Stroud, D. R. Brothwell and M. H. Williamson (eds) *The Jewish Burial Ground at Jewbury*: 427-435. Archaeology of York 12/3.

Stroud, G. 1993. The Human Bones. In G. Stroud and R. L. Kemp (eds) *Cemeteries of the Church and Priory of St Andrew, Fishergate*: 160-173. Archaeology of York 12/2.

Stroud, G. & R. L. Kemp 1993. Cemeteries of the Church and Priory of St Andrew, Fishergate. *Archaeology of York* 12/2.

Stuart-Macadam, P. 1995. Biocultural Perspectives on Breastfeeding. In P. Stuart-Macadam and K. A. Dettwyler (eds) *Breastfeeding: Biocultural Perspectives*: 1-37. New York: Aldine de Gruyter.

Sudha, S. S. I. R. 1999. Female Demographic Disadvantage in India 1981-1991: Sex Selective Abortions and Female Infanticide. *Development and Change* 30: 585-618.

Sundrick, R. I. 1978. Human Skeletal Growth and Age Determination. *Homo* 29: 228-249.

Super, C. 1984. Sex Differences in Infant Care and Vulnerability. *Medical Anthropology* 10: 84–90.

Sutter, R. 2003. Nonmetric Subadult Skeletal Sexing Traits: I. A Blind test of the Accuracy of Eight Previously Proposed Methods using Prehistoric Known-Sex Mummies from Northern Chile. *Journal of Forensic Science* 48: 1-9.

Tarlow, S. 2000. Emotion in Archaeology. *Current Anthropology* 41(5): 713-746.

Temkin, O. 1956. *Soranus Gynaecology*. London: John Hopkins Press.

Teschler-Nicola, M., F. Gerold & W. Prodinger 1998. Endocranial Features in Tuberculosis. *Proceedings of the XIIth European Meeting of the Palaeopathology Association. SPA : Italy; 92.*

Thomas, C., B. Sloane & C. Phillpotts 1997. *Excavations at the Priory and Hospital of St Mary Spital, London*. London: MoLAS Monograph Service 1.

Thomson, A. 1899. The Sexual Differences in the Foetal Pelvis. *Journal of Anatomy and Physiology* 33: 359-380.

Thrupp, S. L. 1966. Plague Effects in Medieval Europe: Demographic Effects of Plague: A Comment on J. C. Russell's Views. *Comparative Studies in Society and History* 8(4): 474-483.

Thrupp, S. L. 1948. *The Merchant Class of Medieval London, 1300-1500*. Chicago: The University of Chicago Press.

Timby, J. R. 1996. *The Anglo-Saxon Cemetery at Empingham II, Rutland: Excavations carried out between 1974 and 1975*. Oxford: Oxbow Monograph 70.

Tocheri, M. W. & J. E. Molto 2002. Aging Fetal and Juvenile Skeletons From Roman Period Egypt Using Basiocciput Osteometrics. *International Journal of Osteoarchaeology* 12: 356-363.

Tooley, M. 1983. *Abortion and Infanticide*. Oxford: Clarendon Press.

Tooley, M. 1973. A Defence of Abortion and Infanticide. In J. Feinberg (ed.) *The Problem of Abortion*: 51-91. Belmont: Wadsworth.

Trivers, R. L. & D. E. Willard 1973. Natural Selection of Parental Ability to Vary the Sex Ratio of Offspring. *Science* 179: 90-92.

Tucker, N. 1977. *What is a Child?* London: Open Books.

Ubelaker, D. H. 1999. *Human Skeletal Remains: Excavation, Analysis, Interpretation* (3rd edn). Washington DC: Taraxacum Press.

Ucko, P. J. 1969. Ethnography and Archaeological Interpretation of Funerary Remains. *World Archaeology* 1: 262-80.

Ulijaszek, S. J. & D. A. Kerr 1999. Anthropometric Measurement Error and the Assessment of Nutritional Status. *British Journal of Nutrition* 82: 165-177.

UnitedNations. 2007. *Demographic Year Book 59.* New York: Department of Economic and Social Affairs http://unstats.un.org/unsd/demographic/products/dyb/dybsets/2007%20DYB.pdf (consulted consulted 12/05/2010).

Upex, B. R. 2006. *A Bio-Cultural Analysis of the Mid to Late Anglo-Saxon Cemetery at Eccles, Kent* University of Bradford Unpublished MSc Dissertation.

Uyenoyama, M. K. & B. O. Bengtsson 1979. Towards a Genetic Theory for the Evolution of the Sex Ratio. *Genetics* 93: 721-736.

Van der Elst, C. W., W. S. Dempster, D. L. Woods & H. d. V. Heese 1986. Serum Zinc and Copper in Thin Mothers, their Breast Milk and their Infants. *Journal of Tropical Pediatrics* 32(3): 111-114.

Veisson, M. 1999. Depression Symptoms and Emotional States in Parents of Disabled and Non-Disabled Children. *Social Behaviour and Personality* 27(1): 87-97.

Verneau, R. 1875. *Le Bassin dans les Sexes et dans les Races*. Paris:

Vlak, D., M. Roksandic & M. A. Schillaci 2008. Greater Sciatic Notch as a Sex Indicator in Juveniles. *American Journal of Physical Anthropology* Online consulted 03/10/08: 1-7.

Voland, E. 1998. Evolutionary Ecology of Human Reproduction. *Annual Review of Anthropology* 27: 347-374.

Voland, E., R. I. M. Dunbar, C. Engel & P. Stephan 1997. Population Increase and Sex-Biased Parental Investment in Humans: Evidence from 18th- and 19th-Century Germany. *Current Anthropology* 38(1): 129-135.

vom Saal, F. S. 1994. The Role of Social, Religious and Medical Practices in the Neglect, Abuse, Abandonment and Killing of Infants. In S. Parmigiani and F. S. v. Saal (eds) *Infanticide and Parental Care: Proceedings of a Workshop Held at the International School of Ethology, Ettore Majorana Centre for Scientific Culture, Italy, 13-20 June 1990*: 43-71. Reading: Harwood Academic.

Waldron, I. 1998a. Factors Determining the Sex Ratio at Birth. In U. Nations (ed.) *Too Young to Die: Genes or Gender?*: 53-63. New York: United Nations Department of Economic and Social Affairs.

Waldron, I. 1998b. Sex Differences in Infant and Early Childhood Mortality: Major Causes of Death and Possible Biological Causes. In U. Nations (ed.) *Too Young to Die: Genes or Gender?*: 64-83. New York: United Nations Department of Economic and Social Affairs.

Waldron, T. 2005. The Human Remains in J. Murray. Excavation of a Medieval Cemetery at Crowland Road, Haverhill. *Proceedings of the Suffolk Institute of Archaeology and History* XLI(1): 26-39.

Waldron, T. 2001. *Shadows in the Soil: Human Bones and Archaeology*. Stroud: Tempus.

Waldron, T. 1994a. *Counting the Dead – The Epidemography of Past Populations*. Chichester: Wiley.

Waldron, T. 1994b. The Human Remains. In V. I. Evison (ed.) *An Anglo-Saxon Cemetery at Great Chesterford, Essex*: 52-66. Council for British Archaeology Research Report 91.

Waldron, T. & L. F. Ruffano 2006. *The Skeletal Analysis of an Anglo-Saxon Population from Cherry Hinton, Cambridgeshire*. Unpublished Report:

Waldron, T., G. M. Taylor & D. Rudling 1999. Sexing of Romano-British Baby Burials from the Beddingham and Bignor Villas. *Sussex Archaeological Collections* 137: 71-9.

Walker, N. & S. McCabe 1968. *Crime and Insanity in England* Edinburgh: Edinburgh University Press.

Walker, P. L. 1995. Problems of Preservation and Sexism in Sexing: Some Lessons from Historical Collections for Palaeodemographers. In S. R. Saunders and A. Herring (eds) *Grave Reflections: Portraying the Past through Cemetery Studies*: 31–47. Toronto: Canadian Scholars' Press.

Walker, P. L., R. R. Bathurst, R. Richman, T. Gjerdrum & V. A. Andrushko 2009. The Causes of Porotic Hyperostosis and Cribra Orbitalia: A Reappraisal of the Iron-Deficiency-Anemia Hypothesis. *American Journal of Physical Anthropology* 139: 109–125

Walker, P. L., J. R. Johnson & P. M. Lambert 1988. Age and Sex Biases in the Preservation of Human Skeletal Remains. *American Journal of Physical Anthropology* 76: 183 – 188.

Walsh-Haney, H., C. Katzmarzyk & A. B. Falsetti 1999. Identification of Human Skeletal Remains: Was He a She or She a He? In S. I. Fairgrieve (ed.) *Forensic Osteological Analysis: A Book of Case Studies*: 17-35. Springfield Illinois: Charles C. Thomas.

Ward, B. 2009 *pers. comm*. Leominster Infant Excavated by Archaeological Investigations,

Ward, J. C. 1992. *English Noblewomen in the Later Middle Ages* The Medieval World. London: Longman.

Washburn, T. C., D. N. Medearis & B. Childs 1965. Sex Differences in Susceptibility to Infections. *Pediatrics* 35: 57-64.

Watts, D. 1989. Infant Burials and Romano British Christianity. *Archaeological Journal* 46: 372-383.

Watts, L. & P. Leach 1996. *Henley Wood, Temples and Cemetery Excavations 1962-69 by the Late Ernest Greenfield and Others*. York: Council for British Archaeology Research Report 99.

Weaver, D. S. 1980. Sex Differences in the Ilia of a Known Sex and Age Sample of Fetal and Infant Skeletons. *American Journal of Physical Anthropology* 52: 191-195.

Webster, L. E. & J. Cherry 1975. Medieval Britain in 1974. *Medieval Archaeology* 19: 220-260.

Webster, L. E. & J. Cherry 1974. Medieval Britain in 1973. *Medieval Archaeology* 18: 174-223.

Webster, L. E. & J. Cherry 1972. Medieval Britain In 1971. *Medieval Archaeology* 16: 147-212.

Weiss, K. M. 1976. Demographic Theory and Anthropological Inference. *Annual Review of Anthropology* 5: 351-381.

Wells, C. 1996. The Human Bones. In V. I. Evison and P. Hill (eds) *Two Anglo-Saxon Cemeteries at Beckford, Hereford and Worcester*. York: Council for British Archaeology Research Report 103.

Wells, C. 1967. Report on the Human Skeletons from Red Castle, Thetford, In G.M. Knocker, Excavations at Red Castle. *Norfolk Archaeology* 34: 155-186

Wells, C., G. Grainger, B. Denston, S. C. Hawkes & J. Bayley 2003. The Inhumations and Cremations. In S. C. Hawkes and G. Grainger (eds) *The Anglo Saxon Cemetery at Worthy Park, Kingsworthy near Winchester, Hampshire* Oxford University School of Archaeology: Monograph No. 59.

Wemple, S. F. 1993. Consent and Dissent to Sexual Intercourse in Germanic Societies from the Fifth to the Tenth Century. In A. E. Laiou (ed.) *Consent and Coercion to Sex and Marriage in Ancient and Medieval Societies*: 227-243. Washington, D.C.: Dumbarton Oaks Research Library and Collection.

Weston, D. A. 2008. Investigating the Specificity of Periosteal Reactions in Pathology Museum Specimens. *American Journal of Physical Anthropology* 137: 48-59.

White, T. D. & P. A. Folken 2005. *Human Bone Manual* (2nd edn). London: Elsevier Academic Press.

White, T. D. & P. A. Folken 1999. *Human Osteology* (2nd edn). New York: Academic Press.

White, W. 1988. *Skeletal Remains from the Cemetery of St Nicholas Shambles, City of London*. London: London and Middlesex Archaeological Society Special Paper No. 9.

Whitelock, D. 1979. *English Historical Documents I c.500-1042* (2nd edn). London: Eyre Methuen.

Whitelock, D. 1961. *The Beginnings of English Society* Pelican History of England 2. Harmondsworth: Penguin.

Whittaker, D. 2000. Ageing from the Dentition. In M. C. S. Mays (ed.) *Human Osteology in Archaeology and Forensic Science*: 83-99. London: Greenwich Medical Media.

Wiggins, R., A. Boylston & C. Roberts 1993. *Report on the Human Skeletal Remains from Blackfriars, Gloucester (19/91)*. University of Bradford: Calvin Wells Laboratory.

Wilczynski, A. 1995. Child Killing by Parents: A Motivational Model. *Child Abuse Review* 4: 365-370.

Wileman, J. 2005. *Hide and Seek : The Archaeology of Childhood*. Stroud: Tempus.

Wiley, A. S. & I. L. Pike 1998. An Alternative Method for Assessing Early Mortality in Contemporary Populations. *American Journal of Physical Anthropology* 107: 315–330.

Wilkinson, D. & A. McWhirr 1998. *Cirencester Anglo-Saxon Church and Medieval Abbey*. Cirencester Excavations IV: Cirencester: Cotswold Archaeological Trust Ltd.

Wilkinson, J. L. 1998. Analysis of Skeletal Remains. Volume 1: Summary of Findings & Photographs. In A. Manning (ed.) *Excavations at Carmarthen Greyfriars 1983-1990*. http://www.acadat.com/projects/CGF/Intro.htm:

Williams, A. N. 2001. Too good to be true? Thomas Willis—neonatal convulsions, childhood stroke and infanticide in seventeenth century England. *Seizure* 10: 471-483.

Williams, G. 1978. The Legal Evaluation of Infanticide. In M. Kohl (ed.) *Infanticide and the Value of Life*: 115-129. Buffalo, New York: Prometheus Books.

Williams, H. 2006. *Death and Memory in Early Medieval Britain*. Cambridge: Cambridge University Press.

Williams, H. R. M. 1999. Identities and Cemeteries in Roman and Early Medieval Britain. In C. F. P. Baker, S. Jundi & R. Witcher (ed.) *TRAC 1998. Proceedings of the Eighth Annual Theoretical Roman Archaeology Conference*: 96-107. Oxford: Oxbow Books.

Williamson, L. 1978. Infanticide: An Anthropological Analysis. In M. Kohl (ed.) *Infanticide and the Value of Life*: 61-75. Buffalo, New York: Prometheus Books.

Williamson, N. E. 1976. *Sons or Daughters: A Cross-Cultural Survey of Parental Preferences*. London: Sage Publications.

Wilson, D. R. 1992. *Anglo-Saxon Paganism*. London: Routledge.

Wilson, S. 1988. Child Abandonment, and Female Honour in Nineteenth-Century Corsica. *Comparative Studies in Society and History* 30(4): 762-783.

Wing, E. S. & A. B. Brown 1979. *Paleonutrition: Method and Theory in Prehistoric Foodways*. London: Academic Press.

Wood, J. W., G. R. Milner, H. C. Harpending & K. M. Weiss 1992. The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples. *Current Anthropology* 33: 343- 370.

Yanagisako, S. J. 1979. Family and Household: The Analysis of Domestic Groups. *Annual Review of Anthropology* 8: 161-205.

Zhu, W. X., L. Lu & T. Hesketh 2009. China's Excess Males, Sex Selective Abortion, and One Child Policy: Analysis of Data from 2005 National Intercensus Survey. *British Medical Journal* 338: 1-6.

Zunshine, L. 2005. *Bastards and Foundlings: Illegitimacy in Eighteenth Century England*. Columbus: The Ohio State University Press.

Appendix 1

Anglo-Saxon Sites

1 Cannington, Somerset

Excavations at Old Cannington Quarry uncovered a fourth to eighth-century cemetery containing 542 supine inhumations orientated west-east (Rahtz *et al.* 2000: 59). Many hundreds of burials are known to have been destroyed by quarrying to the south of the site but the limits of the cemetery were reached on the west, north, and east sides during the excavation (Rahtz *et al.* 2000: 59). The cemetery contained 387 adults (197 females, 127 males) and 155 juveniles, and it would appear from the overall plan that the graves are not grouped according to age or sex (Rahtz *et al.* 2000: 59). The best preserved are the bones of those estimated to have died as adults (15-49 years); the bones of the more elderly are somewhat less well preserved, on the whole infants and children's bones are in the worst condition (Rahtz *et al.* 2000: 72). The human remains are currently curated at the Natural History Museum, London.

2 Henley Wood, Somerset

Excavations at Henley Wood in Somerset between 1962-64 revealed a compact, rural hilltop cemetery dated to the 5th to 7th centuries that overlay an earlier Roman religious site (Watts & Leach 1996: 75). Most of the 75 inhumations were supine extended and orientated west-east, although a few were orientated north-south, and of 'very good' or 'average' preservation (Watts & Leach 1996: 75). There were possible examples of timber grave linings or coffins if the inhumations contained grave goods they were of minor items and certainly none was richly accompanied (Watts & Leach 1996: 75). The cemetery was mixed in terms of sex and age, although some elements were under-represented in the excavated population, especially infants, juveniles and, to a lesser extent, women (Watts & Leach 1996: 75). There were two small concentrations of infant burials, both on the inner periphery of the graves to the east of the temples (Watts & Leach 1996: 55). This may have been due as much to lack of soil depth here as to the presence of boundaries or liminal zones (Watts & Leach 1996: 55). The human remains are currently curated at the North Somerset Museum, Weston-Super-Mare.

3 Cirencester Abbey

Excavations on the site of the Augustinian Abbey at St Mary, Cirencester were completed during 1964 and 1966 by the Cirencester excavation committee on behalf of the then Ministry of Public Building and Works in response to threat from development (Wilkinson & McWhirr 1998: 1). The substantial remains of a an Anglo-Saxon minster church, founded in the reign of Ecgbert (802-39), were revealed below the nave of the abbey church comprising of nave, aisles and apsidal eastern end with a crypt beneath (Wilkinson & McWhirr 1998: 1). Not all of the burials from this multi-period site were excavated, however, twenty-one Anglo-Saxon inhumations were recovered (Heighway *et al.* 1998: 163). The human remains are currently curated at the Corinium Museum Cirencester.

4 Lechlade Butler's Hill, Gloucestershire

Proposed development led to the excavation of Butler's Field in 1985 revealed a large Anglo-Saxon cemetery dating to the early 6th to the later seventh or early eighth century AD (Boyle 1998: 35). The cemetery had two phases; the first was segregated into zones for males, females and cremations with the graves orientated mainly north-south, whilst the later seventh-century burials were orientated east-west and were particularly rich and contained a number of imported grave goods. A total of 219 inhumations from 199 graves were recovered in varying states of preservation including 50 males, 89 females, five unsexed adults and 75 subadults, as well as 29 cremations (Boyle 1998: 35; Harman 1998: 43). Inhumation 95, a premature baby of about seven months *in utero*, was buried with a woman aged between 35 and 40 years (Harman 1998: 44). The human remains are currently curated at the Corinium Museum Cirencester.

5 St Oswalds Priory Gloucester, Gloucestershire

Excavations at the ruins of St Oswald's Priory, which stand in an open space a few hundred yards north-west of Gloucester Cathedral, took place between 1975 and 1983 (Heighway & Bryant 1999: xi). The Anglo-Saxon cemetery extended both north-west, north-east and south of the church (Heighway & Bryant 1999: 195). Most of the individuals recovered had suffered from post mortem breakage and were far from complete skeletons (Rogers 1999: 229). One hundred and forty-one Anglo-Saxon individuals were identified including forty-two males, thirty females and twenty-two subadults (Rogers 1999: 230). The human remains are currently curated by Gloucester City Museum.

6 Beacon Hill, Lewknor, Oxfordshire

The cemetery was situated the western foot of a promontory of the Chilterns known as Beacon Hill, half a mile from the present village of Lewknor (Booth *et al.* 2007: 271; Chambers 1973: 138). Thirty-nine separate burials were recorded, although the full extent of the cemetery was not revealed (Booth *et al.* 2007: 271; Chambers 1973: 140). The graves at Beacon Hill displayed a noticeable lack of order in orientation and in spacing, and less than half of the burials lay entirely undisturbed (Chambers 1973: 145). The cemetery population comprised a mix of adult men and women, children, infants and one instance (Grave 33) of a woman buried with a neonatal infant (Booth *et al.* 2007: 272; Chambers 1973: 142; Harman 1976: 82). Most of the bones were in good condition though some skeletons were poorly preserved, and most of the skulls and some of the postcranial bones were broken (Harman 1976: 80). The human remains are currently curated by the Oxford Museums Service.

7 New Wintles, Oxfordshire

New Wintles was the name given to the four excavations carried out in the area between the villages of Eynsham and Church Hanborough from 1968 to 1972 prior to gravel working, the individual excavations are identified by the letters A to D (Clayton 1973: 382). Each excavation revealed part of what appears to be an extensive settlement site of the 6^{th} to 8th centuries A.D., possibly a single farmstead with scattered cottages or outbuildings (Chadwick Hawkes & Gray 1969: 3; Clayton 1973: 382). The Anglo-Saxon features include four or five timber buildings, a well, scattered pits of various sizes, twenty one sunken huts, and four burials; one in the centre of the small circle in site C, and three in open ground in sites A and D (Clayton 1973: 384). The human remains are currently curated at the Duckworth Laboratory, Cambridge University.

8 Queenford Farm, Oxfordshire

Located 0.7km north of Dorchester-on-Thames, the site of Queenford Farm was discovered by a gravel extraction company in 1972 and was the focus of a short rescue excavation that yielded 82 graves, although most of the bones from this excavation were later destroyed (Chambers 1987: 35; Fuller *et al.* 2006b: 45). Construction of the Dorchester bypass in 1981 allowed the site to be excavated again with another 82 burials salvaged (Fuller *et al.* 2006b: 45). It was estimated that even between these two excavations only 12% of total cemetery had been excavated (Chambers 1987: 40). Five radio carbon dates were obtained for the cemetery giving a date range of AD 430-630 at 93% confidence level (Chambers 1987: 58). However, the excavators have argued that the orderly layout and internal organisation within the cemetery, the practice of west-east, inhumation and the absence of both grave-goods and cremations all suggest that this cemetery may have served the/Christian element of the late- and sub-Roman town (Chambers 1987: 63). These apparently late dates for Queenford Farm are unusual and controversial, as they indicate that Roman burial practices and traditions were still being followed in this region well beyond the fall of Roman rule in Britain with the rural population seemingly slower to adopt the Saxon customs (Fuller *et al.* 2006b: 46). The human remains are currently curated by the Oxford Museums Service.

9 Stanton Harcourt, Oxfordshire

The excavation of a bronze age barrow at Stanton Harcourt in 1940 by Oxford University Archaeological Society prior to airfield construction led to the discovery on the periphery of the circle of twenty-three inhumations dating to the pagan Anglo-Saxon period, probably the sixth to seventh-century (Harden & Treweeks 1945: 33). Four adult males, three adult females, five children and eleven infants were recovered but in varying states of preservation, some of which extremely poor (Harden & Treweeks 1945: 34). Among the inhumations the preponderance of infants and young children is very remarkable (Harden & Treweeks 1945: 33). The human remains are currently curated at the Natural History Museum, London.

10 Watchfield, Oxfordshire

Construction of Shrivenham bypass led to the discovery and subsequent excavation in 1983 and 1989 of forty three inhumations and two cremations from a five to sixth-century Anglo Saxon cemetery at Watchfield, although the cemetery was only partially excavated (Harman 1992: 214; Marlow 1992a: 215). Preservation was very variable, with only a few complete skeletons, and the remains of infants tended to be in a poor condition (Marlow 1992a: 215). All except two of the inhumations were orientated north-south, the exceptions being two infant burials oriented east-west. The human remains are currently curated by the Oxford Museums Service.

11 Raunds, Northamptonshire

Excavations at Raunds Furnells, Northamptonshire began in 1977 and continued until 1984; the work was carried out in a joint effort by the Northamptonshire Archaeology Unit and English Heritage (Boddington 1996: 1). The excavations uncovered a small late-ninth-century church adjacent to an enclosure and buildings which are thought to have developed into the Domesday manor of Bugred (Boddington 1987a: 411; 1987b: 27). Burials were gradually interred in the cemetery over the following two centuries, commencing immediately adjacent to the church and subsequently expanding to fill the entire graveyard (Boddington 1987a: 411). By the end of the eleventh century the tiny church had been replaced by a larger building; this second church was short-lived and early in the twelfth century it was converted into one of the principal buildings of the manor house complex; at the same time the graveyard ceased to be used (Boddington 1987a: 411).

The survival of bone within the graveyard was generally good though in some graves the bone had become heavily broken and crushed, or had largely decayed or disappeared (Boddington 1987b: 31). Spatial imbalances between male and female burials have been identified at Raunds (Buckberry 2007: 123) with females preferentially displaced to the west of the church (Boddington 1987a: 412). There were more adult males than females recovered from the cemetery, although the difference is not statistically significant (Boddington 1996: 29; 1987a: 417). Children aged between two and twelve form 25% of the population overall and were reasonably well represented in most zones but notably a concentration of infants were found adjacent to the church walls in the 'eaves-drip' zone (Boddington 1987a: 419). The human remains are currently curated at the Biological Anthropology Research Laboratory, University of Bradford.

12 Barrington Edix Hill, Cambridgeshire

Excavation from 1989 to 1991 by Cambridgeshire County Council Archaeologists uncovered about a half of the surviving sixth to seventh-century inhumation cemetery overlying earlier features the brow of Edix Hill, Barrington (Malim & Hines 1998). No boundaries were found surrounding the cemetery, although the site was only partially excavated (Devlin 2007: 66). There was a tendency for people to be buried with their head in the south and west, organization seems to have been on the basis of family or household groups although there was also a concentration of subadult burials on the brow of the hill (Devlin 2007: 66). A total of 149 individuals were recovered from 115 graves with eighteen examples of multiple burial (Malim & Hines 1998). The human remains are currently curated by Cambridgeshire Archaeology.

13 Burwell, Cambridgeshire

Workmen at the Victoria Lime Pits in Burwell discovered about fourteen skeletons between 1884 and 1925. However, archaeological excavations were not undertaken until Lethbridge's investigations between 1925 and 1928 on the land adjoining the Pits at the encouragement of the landowner Dr Lucas of Burwell (Lethbridge 1926: 73). A total of 127 burials were found in shallow graves in the chalk, arranged in an orderly manner with no evidence of intercutting of the graves (Lethbridge 1926: 73). The human remains are currently curated at the Duckworth Laboratory at the University of Cambridge.

14 Cherry Hinton, Cambridgeshire

Excavations carried out at Church End, Cherry Hinton, by Hertfordshire Archaeological Trust (now Archaeological Solutions) in 1999 revealed a cemetery associated with an early medieval church, yielding skeletal remains of 683 individuals (Patrick 2006: 347; Waldron & Ruffano 2006: 3). No absolute dates were obtained from the site but based on the east-west orientation of inhumations, distribution of burials in rows, lack of grave goods, and parallels with similar cemetery sites elsewhere it has been estimated that the church and the cemetery were in use around AD 950–1120 (Patrick 2006: 347; Waldron & Ruffano 2006: 2). The church and cemetery were deserted by the twelfth century, with burial apparently transferring to the medieval church of St Andrew, although it is not certain whether this church was contemporary with or a successor to the excavated church, although it does appear that the associated settlement was also relocated at this time (Hadley 2007: 199).

The extent of the cemetery was revealed to the east and south where a large enclosure ditch probably created during the ninth century was discovered (Waldron & Ruffano 2006: 1). The north and western bounds of the cemetery continue beyond the limits of the excavation and due to the dense nature of the burials in this area it is highly probable that the cemetery extends substantially beyond the area excavated (Waldron & Ruffano 2006: 1). At least 405 adults were identified during the osteological analysis including 204 males and 179 females (Waldron & Ruffano 2006: 12). A high proportion of subadults were recovered from the site with 278 individuals aged under 15 years (Waldron & Ruffano 2006: 12). Some clustering was apparent on the site as over 50% of the neonates were interred under the church eves (Waldron & Ruffano 2006: 127). The human remains are currently curated by Cambridgeshire Archaeology.

15 Station Road, Gamlingay, Cambridgeshire

Excavations in 1997 at Station Road Gamlingay in Cambridgeshire uncovered a seventh-century inhumation cemetery, together with thirteen sunken-featured buildings (Murray & Macdonald 2005: 181). The cemetery comprised at least 118 separate graves aligned east–west, and was principally confined to an area 40 m x 40m bounded to the north and east by enclosure ditches (Murray & Macdonald 2005: 199). Despite heavy ploughing on the site the skeletons remained reasonably well preserved although some compression of the skeletons was evident (Murray & Macdonald 2005: 199). The population profile of the discrete burials from Gamlingay comprised thirty infants, fourteen juveniles and seventy-two adults (Murray & Macdonald 2005: 264). There was a mix of male and female burials, although nearly half remained unsexed (Murray & Macdonald 2005: 264). A cluster of infant and juvenile burials seems to occupy the central part of the main cemetery (Murray & Macdonald 2005: 266). The human remains are currently curated by Cambridgeshire Archaeology.

16 Norwich North East Bailey, Norfolk

Excavation was undertaken in 1979 by Norfolk archaeological Unit prior to redevelopment by Anglia Television of part of the north-east Bailey area of Norwich Castle (Ayres 1985: 1). The excavation uncovered a previously unknown pre-Norman church and associated graveyard dating to the eleventh century (Ayres 1985: 1). The cemetery was only partially excavated as no boundaries were located during the investigation so the extent remains unknown (Ayres 1985: 57). The burials appeared to be generally buried in rows with most being 'simple' without coffins or grave furnishings (Ayres 1985: 57). A total of 112 individuals were excavated, a high proportion (62.5%) of which were subadults (Stirland 1985: 51). This could be the result of social grouping at the site where most of the foetal remains appear to be associated with Building B, being sealed by or in close association with the Chancel of Building C (Ayres 1985: 58). The children's graves in general, while being scattered over much of the excavated area, did have a concentration immediately east and north of the chancel (Ayres 1985: 58). The human remains are currently curated at Norwich Castle Museum.

17 St Martin's Church Thetford (Redcastle Furze), Norfolk

Limited excavations carried out for the Ministry of Works by Group Captain Guy Knocker (1967) in 1957 and 1958 at the twelfth-century ring work known as Red Castle revealed the buried remains of the east end of an eleventh-century church, and an associated burial ground to the south and east of it. It has been suggested that this may have been the St Martin's Church recorded in the Domesday survey of 1086, but whose exact location is not mentioned (Knocker 1967). The inhumations in the burial ground were tightly packed and much disturbed, although at least eighty five individuals were identified in the osteoarchaeological analysis of which the sixty-one were adults and twenty-four children (Wells 1967: 155). The human remains are currently curated at Norwich Castle Museum.

18 Great Chesterford, Essex

Excavations in 1953-57 by Evison to the north of the walled Roman town of Great Chesterford revealed a mixed fifth-century cemetery containing 160 inhumations and 33 cremations (Evison 1994: 31). Only the west and south limits of the cemetery were found (Evison 1994: 31). During the long period between excavation in the 1950's and post excavation dissemination in the early 1990's most of the bones came to be stored together in anatomical groups rather than as separate individuals leading to some confusion of identity when the osteoarchaeological analysis was completed for the published report, although the skeletons are now stored as separate individuals (Evison 1994: 31; Waldron 1994b: 52). A total of 171 inhumations were excavated from Great Chesterford including 42 adult males, 63 adult female, and unusually for this period a high number (86) of subadults below the age of fifteen were recovered (Waldron 1994b: 53). There were 65 infant and foetus inhumations, including two foetuses (32 and 127) found in the pelvis of the mother, who may have died of some complication of pregnancy (Waldron 1994b: 53). The human remains are currently curated at the Archaeology Department at Southampton University.

19 Bradstow School, Kent

An Anglo-Saxon inhumation cemetery found and excavated at Valetta House (now Bradstow School) in 1910-11 by H. Hurd revealed some 15 inhumations with accompanying grave goods. Further excavations by a team from the British Museum between 1970-4 located another 98 Saxon inhumations (Webster & Cherry 1975: 223; 1972: 156). Interim reports were published by Webster and Cherry (1975; 1974; 1972) but the full findings remain unpublished (Diack 2004: 19). The cemetery started in the late fifth century, but was most intensively used in the period 600-800. Most of the graves were aligned east-west, many had structural features, including post-holes, sockets, ledges and small ring ditches and several of the graves appear to have been robbed soon after interment (Webster & Cherry 1975: 223; 1972: 156). There were twice as many male as female inhumations although it was thought that the cemetery had still not been fully investigated when the excavations were terminated (Webster & Cherry 1975: 223). The human remains are currently curated at the Natural History Museum, London.

20 Dover Buckland, Kent

Construction of a housing estate in 1951 next to part of the Dover to Deal branch railway line uncovered a late fifth to early-eighth-century cemetery containing one hundred and fifty four inhumations excavated by Evison between 1951 and 1953 (Evison 1987: 11). The majority of the graves were positioned with the head generally towards the west, following the contour of the hill-slope (Devlin 2007: 63; Evison 1987: 16). Many of the graves were shallow and the bone poorly preserved with only the more robust bones present and those tended to be in a crumbling state (Evison 1987: 16). Male, female and juvenile graves are scattered throughout the cemetery, but a certain amount of grouping according to sex and age can be distinguished (Evison 1987: 145). In 1994 another housing estate was laid out on the other side of the railway cutting led to further archaeological investigation by the Canterbury Archaeological Trust which revealed the rest of the cemetery measuring 1.3 hectares, although part of the cemetery must have been destroyed during the construction in 1879/80 of the railway line that cuts the two excavated areas (Parfitt 1995: 459). Preservation from this excavation was again very poor with the excavation of twenty six empty graves believed to be the graves of children due to their size (Parfitt 1995: 463). The human remains from the 1950's excavations are currently curated at the Natural History Museum, London and those excavated in 1994 are curated by the Canterbury Archaeological Trust.

21 Eccles, Kent

The Anglo-Saxon cemetery at Eccles, dating from the fifth to possibly the eighth century, was extensively excavated at the site of an earlier Roman villa in the 1960s and 1970s although the excavations have not been fully published (Upex 2006: 10).

The remains of around 200 individuals were recovered from east - west aligned graves in the cemetery as well as large quantities of un-stratified and mixed human remains due to the high level of grave disturbance (Drewett *et al.* 1988: 271; Upex 2006: 1). The number of subadults is lower than expected although the bones of at least four foetal/neonatal individuals were recovered (Boocock *et al.* 1995: 3). The human remains are currently curated at the Biological Anthropology Research Laboratory at the University of Bradford.

22 Finglesham, Kent

The sixth to early eighth-century inhumation cemetery in West Street, Finglesham, was on a prominent knoll of bare down land chalk on the easterly edge of the North Downs, which has long been under plough (Chadwick Hawkes 1976: 33). During 1928-9 The Kent Archaeological Society excavated over 30 graves under the direction of W.P.D. Stebbing. Further graves were excavated by Chadwick Hawkes between 1959 and 1967 bringing the total number of recovered inhumations to 243 (Chadwick Hawkes 1976: 33; 1958: 1). The graves were not in any orderly arrangement, but only once had one grave cut into another (Chadwick Hawkes 1958: 8). The orientation varied, but was predominantly with the head west-south-west, the bodies seem mostly to have been laid supine, but a few on the side (Chadwick Hawkes 1958: 8). The human remains are currently curated by the Duckworth Laboratory at the University of Cambridge.

23 Holborough, Kent

Chalk excavations by the Associated Portland Cement Manufacturing Company on Holborough Hill in 1950 led to the discovery of human skeletons in a number of graves and the subsequent excavation in 1952-53 by Evison for the Ministry of Works (Evison 1957: 84). The original extent of the cemetery is unknown, since by 1952 a great deal had been destroyed. The graves were quite widely spaced with no intercutting most were lying more or less west to east with the head to the west (Evison 1957: 90). Thirty six individuals were recovered including sixteen adult males and fifteen adult females and five subadults (Denston 1957: 112). There was no obvious grouping with respect to age or sex for the graves of men, women and children are intermingled (Evison 1957: 91). The human remains are currently curated by the Duckworth Laboratory at the University of Cambridge.

24 Alton, Hampshire

The digging of foundations for a new bungalow in 1960 on Mount Pleasant Road in Alton, Hampshire, led to the excavations of forty seven inhumations and forty four cremations dating to around 500 AD (Evison 1988: 1). Whilst it is probable that limits of the cemetery were found to the east and south, the cemetery looked to extend further in a north-westerly direction (Evison 1988: 1). There was no evidence of disturbance to the graves (Evison 1988: 1). A roughly equal representation of the sexes was reported along with juveniles from across the age spectrum (Evison 1988: 32). The human remains are currently curated by the Hampshire Museums Service.

25 Droxford, Soberton, Hampshire

The cemetery was first discovered in 1900 during construction of the Meon Valley railway line when a large number of graves were found, but remain unpublished (Aldsworth & Welch 1978: 93). Further excavations by the Department of the Environment and the Hampshire County Museum Service in 1974 uncovered at least 41 further inhumations including twelve males, twenty-one females and six subadults (Aldsworth & Welch 1978: 93). Most of the burials were orientated east-west but the grave goods suggest a date from the late-fifth century to the sixth century (Aldsworth & Welch 1978: 93). The human remains are currently curated by the Hampshire Museums Service.

26 Nunnaminster (St. Mary's Abbey Winchester) Hampshire

The Nunnaminster (or Nuns' minster, later known as St. Mary's Abbey) was, until the end of the Middle Ages, one of the most important nunneries in England (Biddle & Quirk 1962: 175; Qualmann 1986: 204). The Abbey was founded by King Alfred, who died in 899, for his Queen Elswytha and completed in 908 by Edward the Elder (Biddle & Quirk 1962: 175; Qualmann 1986: 204). In 963 Bishop Aethelwold rebuilt the abbey and enlarged the precinct, the Abbey was then re-dedicated in 1108 but was destroyed by fire during the siege of Winchester in 1141 and subsequently rebuilt this time lasting until the Dissolution in 1539 (Scobie & Qualmann 1993: 15). The earliest graves found on the site, including one adult, one child and four neonatal infants, were associated with Aethelwold's church (Scobie & Qualmann 1993: 22). The human remains are currently curated at the Winchester City Museum.

27 Portway East, Hampshire

Sixty-nine inhumation graves and eighty-seven cremations were excavated from the late fifth or early-sixth-century Anglo-Saxon cemetery at Portway, Hampshire between 1973 and 1975 (Cook & Dacre 1985: 52; Henderson & Wells 1985: 61). The cemetery limits were defined by excavation on three sides: the north, south and east (Cook & Dacre 1985: 52). The burials were arranged in a generally orderly fashion with heads orientated to the south, but there were a few instances of superimposed graves (Cook & Dacre 1985: 53). Many of the burials were extremely shallow, some lying less than 0.4m below the modern land surface (Cook & Dacre 1985: 53). There were no complete skeletons recovered from the site and in most cases the bones that were available were broken or damaged in some way, with the majority being in an poor state of preservation (Henderson & Wells 1985: 61). The human remains are currently curated by the Hampshire Museums Service.

28 Romsey Abbey, Hampshire

The Benedictine Nunnery of Romsey was founded in 907 by Edward the Elder and was suppressed in 1539 (Scott 1996: 37). In 1900 a tenth-century Saxon Church was discovered below the present Norman Abbey, which was built around 1120, and dedicated to St. Mary and St. Ethelfraeda (Scott 1996: xiii). The basic structure of the walls of the transepts of the late Anglo-Saxon abbey was revealed during excavations in 1975 and 1977 (Scott 1996: 38). Two chronologically distinct groups of Anglo-Saxon graves were recovered; the earliest group is aligned NW-SE and located on the north side of the abbey, the second group are aligned east-west and were also found to the north of the abbey (Scott 1996: xiii). The human remains are currently curated by the Hampshire Museums Service.

29 Staple Gardens, Winchester, Hampshire

Excavations between 1984 and 1995 at Staple Gardens uncovered a ninth to eleventh-century Anglo-Saxon inhumation cemetery of at least 288 inhumations (Cherryson 2008: 120; Geake 1997: 156). Almost all of the graves were oriented west-east, the one exception was a triple north-south burial, and most of the burials were supine extended, but there were also five supine burials with flexed legs and one crouched infant burial. Seven burials were placed on beds of charcoal and twelve skeletons had their skulls supported by stones. There was evidence for the use of coffins or wooden linings in a number of graves although most of the graves were unfurnished. The cemetery includes many children as well as adults (Kjølbye-Biddle 1992: 224). The human remains are currently curated at the Winchester City Museum.

30 Winnall II, Hampshire

Excavations in 1958 prior to development of an industrial estate at Winnall revealed forty-five Anglo-Saxon graves in the chalk (Meaney 1970: 29). The graves were approximately oriented west-east, with the heads to the west, with the skeleton usually supine with legs either extended or flexed (Meaney 1970: 29). The cemetery boundaries appear to have been discovered on the northern, eastern and possibly the southern sides, but the western end remains unexcavated and its limits are unknown (Meaney 1970: 29).The burial assemblage suggested a date of 7th-8th centuries as grave goods tended towards basic items of everyday use, principally knives and belt-buckles and were only found with twenty-eight of the inhumations (Meaney 1970: 45). The human remains are currently curated by the Winchester city Museum.

31 Worthy Park, Hampshire

The Anglo-Saxon cemetery at Worthy Park, Kingsworthy, Hampshire is situated three miles up the valley of the River Itchen from Winchester (Hawkes & Wells 1983: 4). The cemetery was discovered in 1944 by the Hampshire Field Club and further excavated in 1961-2 by Mrs. Sonia Hawkes, yielded 96 inhumations and 46 cremations ranging in date from the late fifth into the seventh century (Meaney 1970: 1; Wells *et al.* 2003: 153). The cemetery plan is chaotic with many burials superimposed (Hawkes & Wells 1983: 6). Of the 96 inhumations, 25 (26%) were under 18 years old (Hawkes & Wells 1983: 29). The human remains from this site are currently curated at the Hampshire Museums Service and also at the Duckworth Laboratory, University of Cambridge.

Appendix 2

Medieval Sites

1 Hereford Cathedral, Herefordshire

Plans to erect a building next to the Dean Leigh Library in Hereford led to excavations in the South-West corner of Cathedral Close which uncovered a medieval cemetery dating from the late twelfth to the sixteenth century (Stone & Appleton-Fox 1996: 1). The inhumations were densely packed with 1,085 burials excavated including 215 females, 187 males and 225 children (Stone & Appleton-Fox 1996: 41). After the cemetery had been in use for some time three mass graves were dug, containing at least 189 individuals (Stone & Appleton-Fox 1996: 43). The unusual nature of the burials and the late-fourteenth-century pottery dating evidence suggests the mass graves represent some of Herefords victims of the bubonic plague (Stone & Appleton-Fox 1996: 46). After the mass graves had been completely filled the area they occupied ceased to be used as part of the general cemetery, although the rest of the excavated site continued to be used as a graveyard well into the sixteenth century (Stone & Appleton-Fox 1996: 44). Besides the mass graves there were a number of double burials including the adult female (3409) with the foetus (3410) in breech position (Stone & Appleton-Fox 1996: 44). There was a large degree of intercutting causing much disturbance and possibly the removal of entire graves (Stone & Appleton-Fox 1996: 44). The human remains are currently curated at the Biological Anthropological Research Centre, University of Bradford.

2 Leominster, Herefordshire

An excavation by Archaeological Investigations in 2008 in Leominster uncovered an infant skeleton in a settlement context (Ward 2009). The skeleton came out of a deliberately dug pit under a clay floor from a building dating to between 13th - 15th centuries (Ward 2009). Pottery from the pit gives a date of thirteenth century (Ward 2009). The individual from this site was examined during the post-excavation stage prior to the deposition of the site archive.

3 Cirencester Abbey, Gloucestershire

Excavations on the site of the Augustinian Abbey at St Mary founded by Henry I in Cirencester in 1131, Cirencester were completed during 1964 and 1966 by the Cirencester excavation committee on behalf of the then Ministry of Public Building and Works in response to threat from development (Bryant & Heighway 1998: 7; Wilkinson & McWhirr 1998: 1). Not all of the burials from this multi-period site were excavated, however, thirty-two medieval inhumations were investigated (Heighway *et al.* 1998: 163). Whilst all but two of the adult burials were male, children were recovered from a cluster of thirteenth-century burials to the west of the abbey (Wilkinson & McWhirr 1998: 11). This includes a large thirteenth to fourteenth-century pit found in the south-west corner of the site which contained one adult and six juveniles (B113-115, H124, H137-8), the burials were all individually disposed despite being in the one pit, with at least one example of a coffin (Heighway *et al.* 1998: 167). The human remains are currently curated at the Corinium Museum Cirencester.

4 Gloucester Blackfriars, Gloucestershire

The Dominican Priory of at Gloucester was founded in 1239 by Sir Stephen de Hermshall, consecrated in 1284 and continued in use until the Dissolution in 1539 (Wiggins *et al.* 1993: 3). A ground-probing radar survey revealed an extensive cemetery containing up to 2000 burials and whilst burials at the site commenced in the year 1246, it is clear that this was not just the resting pace for the monastic inhabitants (Wiggins *et al.* 1993: 3). The excavation of 129 discrete burials revealed a mixed population including thirty-three males, twenty-seven females, and fifty one subadults which, along with the high number of individuals displaying pathological changes, led to the suggestion that the friars were providing a hospital service to the community (Wiggins *et al.* 1993: 4). The human remains are currently curated at the Biological Anthropological Research Centre, University of Bradford.

5 St Oswalds Gloucester, Gloucestershire

Excavations at the ruins of St Oswald's Priory, which stand in an open space a few hundred yards north-west of Gloucester Cathedral, took place between 1975 and 1983 (Heighway & Bryant 1999: xi). The minster of St Oswalds was reformed to the Augustinian Order in 1153, the monastery was under the See of York and never prospered, and was suppressed in 1536 (Heighway & Hare 1999: 11). A number of burials post-dated the north transept of *c* 1120 and other burials extended south-west of the church (Heighway & Bryant 1999: 197). The cemetery south and south-west of the church was badly disturbed by nineteenth-century cultivation with much intercutting of graves (Heighway & Bryant 1999: 201). Most of the individuals recovered had suffered from post mortem breakage and were far from complete skeletons (Rogers 1999: 229). Two hundred and fourteen individuals were recovered from the medieval period contexts, including fifty-five males, forty-two females and seventy-seven subadults (Rogers 1999: 230). The human remains are currently curated at Gloucester City Museum.

6 Eynsham Abbey, Oxfordshire

The Benedictine Abbey at Eynsham was founded in 1005 on the site of a seventh of eighth-century minster church (Hardy *et al.* 2003: xxii). The monks fled at the Norman Conquest, but the monastery was restored and re-endowed before 1086, the abbey then prospered for most of the medieval period before the Dissolution in 1538-9 (Hardy *et al.* 2003: xxii). Expansions of the nearby cemeteries of St Peter's and St Leonard's churches have led to trial investigations in 1962-3 by Miss H Sutermeister and D Sturdy, an unpublished excavation by Gray and Clayton in 1971 and a 1800 sq metre excavation within the inner court of the Abbey between 1989 and 1992 by Oxford archaeology (Hardy *et al.* 2003: xxii). The remains studied here were recovered from the Abbey cemetery during the 1971 unpublished excavations by Gray and

Clayton (Hardy *et al.* 2003: 15). The human remains are currently curated by the Duckworth Laboratory at the University of Cambridge.

7 Clopton, Cambridgeshire

The remains of the abandoned late thirteenth century to early fourteenth-century settlement are in and around the present village of Clopton on both sides of the main street. The human remains are currently curated by the Duckworth Laboratory at the University of Cambridge; however, the excavations are unfortunately unpublished.

8 Comet Place, Cambridgeshire

Excavations at Comet Place, in Castlehill Cambridge uncovered part of the churchyard of All-Saints'-by-the-Castle (DuckworthLaboratory 2009). Unfortunately little is known about this medieval church which had disappeared by the sixteenth century (DuckworthLaboratory 2009). The excavations revealed a total of 225 burials including 63 immature individuals (DuckworthLaboratory 2009). The human remains are currently curated by the Duckworth Laboratory at the University of Cambridge.

9 Huntington Orchard Lane, Cambridgeshire

Excavations by the Archaeological Field Unit of Cambridgeshire County Council in 1994 at Orchard Lane, Huntington prior to development of the site revealed an eleventh to fourteenth century cemetery (Oakey & Spoerry 1996: 123). The remains of twenty-one articulated human skeletons were recovered from supine burials aligned west-east with the head to the west (Oakey & Spoerry 1996: 130). The burials had been intensive at the northern end of the site, however, despite the superimposition, there was limited disturbance to earlier inhumations although most of the bone was broken (Duhig 1996: 144; Oakey & Spoerry 1996: 131). With the inclusion of the disarticulated material, a total of fifty one individuals were identified during the osteoarchaeological analysis with thirteen males, nine females and eighteen subadults (Duhig 1996: 144). The human remains are currently curated by Cambridgeshire Archaeology.

10 New Romney (St Martin's Field), Kent

Construction of a sewerage line at St. Martin's Field New Romney, led to the location of thirty-eight inhumation associated with St Martin's churchyard, believed to date between the 1300's and 1530's (Clough & Loe 2005: 1; Diack 2006: 34).The majority of the skeletons were relatively complete with most being judged to have 75% or more of their elements present, and with the exception of two, all the skeletons were in excellent condition (Clough & Loe 2005: 3). The assemblage comprised of 27 adults and 11 subadults, with all age categories from neonate through to old adult being represented, although the cemetery was not completely excavated (Clough & Loe 2005: 3). The human remains are currently curated by Canterbury Archaeological Trust.

11 St Gregory's Priory, Canterbury, Kent

A complete area-excavation in 1988-91 uncovered the Church of St Gregory which was founded around 1084 by Lanfranc, Archbishop of Canterbury (Hicks & Hicks 2001: 1). Lanfranc's original church consisted of a long aisle-less nave and a square chancel to the east with a graveyard sited to the south of the church (Hicks & Hicks 2001: 1). St Gregory's became a priory in 1133 when Archbishop William of Corbeil installed Augustinian cannons (Hicks & Hicks 2001: 1). A total of 1342 articulated skeletons were excavated from the cemetery, church and later priory of St Gregory's (Anderson & Andrews 2001: 338). However, only ninety-one burials associated with the church and priory which lay to the north of High Street St Gregory's were analysed by Anderson and Andrews (2001: 338) for the published the site report. The human remains are currently curated by Canterbury Archaeological Trust.

12 Stonar, Kent

The deserted medieval town and port of Stonar was situated on the north side of the River Stour, opposite Sandwich (Parfitt 2001: 95). The town's church was apparently dedicated to St Nicholas, a plan of the church drawn in 1821 by Mr E F Stratton records the excavation of the church and some burials by Henry Wood Esquire (Parfitt 2001: 95). Subsequent excavations on the site of the church at Stonar were undertaken by Major Gwilym Lloyd George in 1911, although no report of the findings remains (Parfitt 2001: 99). Final rescue excavations in the area of the church were conducted under difficult conditions by Nigel Macpherson-Grant in 1972 ahead of imminent destruction by quarrying (Parfitt 2001: 99). This succeeded in locating the south-eastern corner of the church together with a substantial portion of the associated cemetery, containing over 120 burials (Parfitt 2001: 99). The human remains are currently curated by Canterbury Archaeological Trust.

13 East Smithfield Black Death Cemetery, Greater London

The East Smithfield Black Death cemetery, which was the first established Black Death cemetery in London being in use during 1348-1350, was excavated in 1986-88, although it is estimated that approximately 40-50% of the cemetery is still in-situ below the Royal Mint's courtyard (Bekvalac *et al.* 2007b; Grainger *et al.* 1988: 429). The burials were clustered in two areas with a total of 558 burials excavated from the western cemetery; 300 individuals were uncovered from mass graves and a further 258 from single inhumation graves (Bekvalac *et al.* 2007b). The eastern cemetery revealed 192 individuals; 102 from mass graves and 90 individuals from single inhumations (Bekvalac *et al.* 2007b). The preservation of the material was good although skeletal completeness was poor for the subadults (Bekvalac *et al.* 2007b). The demographic profile for the Black Death individuals revealed 27.8% subadults and 72.2% adults (Bekvalac *et al.* 2007b). The age profile indicated that a majority of the adults died before the age of 35, whilst a majority of the sub adults died over the age of 5 years providing a death curve for a catastrophe cemetery (Bekvalac *et al.* 2007b). The human remains are currently curated by the Museum of London.

14 Guildhall Yard East, Greater London

The Guildhall Yard East site was excavated from Portland House, 72-73 Basinghall Street, EC2 by the Museum of London Archaeological Service between 1992 and 1997 (Cowal 2007). Originally, it was the site of the lay cemetery of St Lawrence Jewry, where the earliest burials are thought to date from the late eleventh century (Cowal 2007). However, several adults could not be sexed due to lack of skeletal completeness the bone quality across the site was excellent with only minor post mortem damage to the ends of long bones (Cowal 2007). From the 68 individuals recovered from the 47 (69.1%) were adults, including 18 (26.5%) males, 15 (22.1%) females and 14 (20.6%) unsexed individuals (Cowal 2007). 21 (30.9%) children were recovered from the site, with 57% being between the ages of 6 and 11 (Cowal 2007). The human remains are currently curated by the Museum of London.

15 St Benet Sherehog, Greater London

The Church and graveyard of St Benet Sherehog was excavated by MOLAS between 1994 and 1996 (Bekvalac & Cowal 2007). The church was originally constructing in the eleventh century in alignment with, but overlaying, the old Roman Road at Poultry (Bekvalac & Cowal 2007). It remained in use until its destruction during the great fire of London in 1666 (Bekvalac & Cowal 2007). The burials were aligned roughly east-west with the heads towards the west end of the graves (Bekvalac & Cowal 2007). Although the overall bone quality was good, the skeletal completeness was generally poor with the majority of the skeletons were less than 25% intact (Bekvalac & Cowal 2007). Of the 39 Medieval individuals recovered there were 24 adults (8 males and 4 females) and 15 sub adults (Bekvalac & Cowal 2007). The human remains are currently curated by the Museum of London.

16 St John Clerkenwell, Greater London

The priory of the order of the Hospital of St John of Jerusalem, Clerkenwell, London, was founded around 1144, this was the head house of the order in England (Sloane & Malcolm 2004). The twelve burials recovered from the priory formed only a part of the original cemetery; assuming a similar density throughout the cemetery, these burials represent only about 12% of the total (Conheeney 2004: 394). The macroscopic condition of the bone was generally moderate to good; 83.3% of the individuals were 60% complete (Conheeney 2004: 395). The sex composition of the sample produced a male to female ratio of 3.5:1 (seven males to two females) (Conheeney 2004: 395). The one subadult recovered was a full-term foetus found in the pelvis of the young female D[549], with the head of the child already rotated down towards the pelvic canal (Conheeney 2004: 399). The human remains are currently curated by the Museum of London.

17 St Mary Graces, Greater London

The large burial ground associated with the Cistercian abbey of St Mary Graces (1350-1540) was uncovered during the excavation of the Royal Mint site between 1986 and

1988 (Bekvalac *et al.* 2007a; Grainger *et al.* 1988: 431). It covered a substantial area and revealed 420 burials that were clustered in two groups referred to as the Churchyard and Abbey Buildings (Bekvalac *et al.* 2007a). The inhumations in the churchyard cemetery which was north of the church and extended westwards were found overlying the earlier western catastrophe cemetery (Bekvalac *et al.* 2007a). These burials, representing a mixed population, took place over a long period of time (Grainger *et al.* 1988: 431). The burials followed a standard medieval Christian burial style and appeared to have no particular differentiation in social status (Bekvalac *et al.* 2007a). Preservation varied across the burial ground but predominantly was not very good (Bekvalac *et al.* 2007a). A total of 389 skeletons were included in the osteological analysis consisting of 283 adults (136 males, 68 females and 79 unassigned sex) and 106 sub adults with only five aged below 1 years old (Bekvalac *et al.* 2007a). The overall male to female ratio was 2:1 with a fairly even distribution through the age categories (Bekvalac *et al.* 2007a). The human remains are currently curated by the Museum of London.

18 St Nicholas Shambles, London

Excavations at St Nicholas Shambles, off Newgate Street by the Museum of London in 1975-7 revealed 189 burials from the 11th and 12th parish cemetery (Schofield 1988: 18).The population of St Nicholas Shambles included 90 males and 71 females, giving and adult sex distribution for the site of 1.27:1 (White 1988: 30). Twenty-six percent of the bodies were those of children and adolescents; twenty were aged under three, twenty-one aged between four and twelve, and thirteen aged between thirteen and eighteen (Wileman 2005: 140). There did not appear to be a favoured location for the burial of children, although a concentration of neonates and young children with adults at the south-western limit of the excavated area and at a second, minor part of the site could be suggestive of the burial of children with their parents (White 1988: 48). The human remains are currently curated by the Museum of London.

19 Spital-Square, Greater London

Large excavations between 1985 and 1989 by the Museum of London at Spital Square, on the northern side of Folgate Street in North East London uncovered the large Augustinian priory and hospital of St Mary Spital (Bekvalac *et al.* 2008). A total of 126 human skeletons were recovered from distinct sections of the site (Bekvalac *et al.* 2008). Nine skeletons were recovered from the priory, dated 1197-1235, 15 individuals were recovered from the first phase of the infirmary Hall/ Chapel dating between 1280 and 1320 (Bekvalac *et al.* 2008). The remaining 102 individuals were recovered from the hospital cemetery, dated 1235-1280 (Bekvalac *et al.* 2008). Of 124 individuals analysed by osteoarchaeologists 43 were males, 23 females and 42 subadults (Bekvalac *et al.* 2008). The combined male to female ratio for the site was almost 2:1 (Bekvalac *et al.* 2008). One third of the burials were subadult but the majority died during adolescence and 24% were aged between 6 and 11 at the time of death (Bekvalac *et al.* 2008). Overall the quality of the bone was good and the majority of individuals were more than 50% complete (Bekvalac *et al.* 2008). The human remains are currently curated by the Museum of London.

20 Cuddington, Surrey

The medieval village of Cuddington, near Ewell Surrey, was demolished by Henry VIII in 1538 for the construction of Nonsuch Palace and its park (Biddle 2005: 1). The excavation of Cuddington Church and its cemetery, was conducted as a secondary aim of the 1959 investigation of Nonsuch Palace directed by Martin Biddle (2005: 5). Dated to *c* 1100 to 1538 Cuddington Church lay below the Inner Court of the later palace and was surrounded on all sides by the graveyard (Biddle 2005: 14). The full extent of the cemetery is unknown although the northern limit appears to be defined by a wall running west to east just to the north of the inner gatehouse (Biddle 2005: 16). One hundred and thirteen burials were excavated from the southeast portion of the cemetery during 1959 although any osteological analysis remains unpublished (Biddle 1961: 7). The human remains are currently curated by the Duckworth Laboratory at the University of Cambridge.

21 Hospital of St. James and St. Mary Magdalene, Chichester, West Sussex

The first excavations of the cemetery associated with the medieval hospital of St. James and St. Mary Magdalene were conducted by the Chichester District Archaeological Unit from 1986 to 1987 in preparation for a housing project (Judd & Roberts 1998: 45; Ortner *et al.* 1991: 92). Further excavations were completed in 1993 in the western end of the cemetery. A total of 374 graves were excavated from the cemetery producing a minimum of 384 individuals. The demographic and pathological profiles of the cemetery confirm a division into two distinct phases, the leprosarium and the almshouse (Lee & Magilton 2008: 263; Magilton 2008: 91). In the earlier, south-western, part of the cemetery (Area A) 84% (106/126) of the adult burials were male, with almost half of them exhibiting some form of leprous change (Lee & Magilton 2008: 263). In the north-eastern part of the cemetery (Area B) which is attributed to the almshouse phase, this is a more normal population structure with a mortality rate of 40% before adulthood (Lee & Magilton 2008: 263). Males still outnumber females throughout, but the percentage of women appears to increase with time which may reflect the gradual admission of women (Lee & Magilton 2008: 263). The Chichester sample comprised 104 children (27.0% of the total sample) with the majority aged between 1.1 and 6.5 years (Lewis 2008: 174). The human remains are currently curated by the Biological Anthropology Research Centre at the University of Bradford.

22 Market Street, Winchester, Hampshire

The 1987 excavations at Market Street in Winchester of a Roman building that was possibly part of the forum of Venta Belgarum funded by United Biscuit also uncovered a medieval cemetery. Unfortunately the results of these excavations have still not been published. The human remains are currently curated by Winchester City Museum.

Appendix 3: Age and Sex Distribution of Perinatal Individuals by Site

Early Anglo-Saxon Sites													
Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Alton, Mount Pleasant	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Barrington Edix Hill	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99		1					1	1	0	-	-	0
	44.00-46.99							0	0	0			
	Total	0	1	0	0	0	0	1	1	0	-	-	0
Beacon Hill	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99			1				1	0	0			
	41.00-43.99				1			1	0	1	-	-	200
	44.00-46.99							0	0	0			
	Total	0	0	1	1	0	0	2	0	1	-	-	200
Bradstow School, Broadstairs	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Burwell	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Cannington	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99		1					1	1	0	-	-	0
	32.00-34.99						2	2	0	0			
	35.00-37.99				1		7	8	0	1	-	-	200
	38.00-40.99	2				1		3	2	1	-	-	50
	41.00-43.99						1	1	0	0			
	44.00-46.99						1	1	0	0			
	Total	2	1	0	1	1	11	16	3	2	-	-	67

Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Dover Buckland	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99				1			1	0	1	-	-	200
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	1	0	0	1	0	1	-	-	200
Droxford	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Eccles	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99					1		1	0	1	-	-	200
	38.00-40.99						1	1	0	0			
	41.00-43.99				1			1	0	1	-	-	200
	44.00-46.99							0	0	0			
	Total	0	0	0	1	1	1	3	0	2	-	-	200
Finglesham	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Great Chesterford	23.00-25.99							0	0	0			
	26.00-28.99						1	1	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99	1					3	4	1	0	-	-	0
	35.00-37.99			1	1	1	8	11	0	2	-	-	200
	38.00-40.99	4		1	4	1	29	39	4	5	-	-	125
	41.00-43.99		5	1		1	1	8	5	1	-	-	20
	44.00-46.99	2	1		1		2	6	3	1	-	-	33
	Total	7	6	3	6	3	44	69	13	9	0.73	0.394	69
Henley Wood	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99	1						1	1	0	-	-	0
	38.00-40.99	3					1	4	3	0	-	-	0
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	4	0	0	0	0	1	5	4	0	-	-	0
Holborough	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			

Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Lechlade Butler's Field	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99	1						1	1	0	-	-	0
	35.00-37.99							0	0	0			
	38.00-40.99			1				1	0	0			
	41.00-43.99	1					1	2	1	0	-	-	0
	44.00-46.99							0	0	0			
	Total	2	0	1	0	0	1	4	2	0	-	-	0
New Wintles	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Portway East	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Queenford Farm	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99				1			1	0	1	-	-	200
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	1	0	0	1	0	1	-	-	200
Redcastle Furze	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99						1	1	0	0			
	41.00-43.99						2	2	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	3	3	0	0			
Stanton Harcourt	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Station Road, Gamlingay	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99						1	1	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99				1			1	0	1	-	-	200
	38.00-40.99	1					1	2	1	0	-	-	0
	41.00-43.99						1	1	0	0			
	44.00-46.99						2	2	0	0			
	Total	1	0	0	1	0	5	7	1	1	-	-	100

Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Watchfield	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Winnall	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Worthy Park	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99	1						1	1	0	-	-	0
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	1	0	0	0	0	0	1	1	0	-	-	0
Late Anglo-Saxon Sites													
Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Cherry Hinton	23.00-25.99	1	1				1	3	2	0	-	-	0
	26.00-28.99							0	0	0			
	29.00-31.99						1	1	0	0			
	32.00-34.99		2	1	2		2	7	2	2	-	-	100
	35.00-37.99	2	1	1		3	10	17	3	3	-	-	100
	38.00-40.99	1	2		5	2	8	18	3	7	1.6	0.206	233
	41.00-43.99		1		1	2	3	7	1	3	-	-	300
	44.00-46.99		1	2	5		3	11	1	5	-	-	500
	Total	4	8	4	13	7	28	64	12	20	2	0.157	167
Cirencester Abbey	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Norwich North-East Bailey	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99			1				1	0	0			
	32.00-34.99					1		1	0	1	-	-	200
	35.00-37.99	1						1	1	0	-	-	0
	38.00-40.99	1			1			2	1	1	-	-	100
	41.00-43.99							0	0	0			
	44.00-46.99	2						2	2	0	-	-	0
	Total	4	0	1	1	1	0	7	4	2	-	-	50

Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Nunnaminster	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Raunds	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99	2						2	2	0	-	-	0
	35.00-37.99	5	1		1	1		8	6	2	-	-	33
	38.00-40.99	7	2		2	2	1	14	9	4	1.92	0.166	44
	41.00-43.99	2				3		5	2	3	-	-	150
	44.00-46.99	1	1			3	2	7	2	3	-	-	150
	Total	17	4	0	3	9	3	36	21	12	2.46	0.117	57
Romsey Abbey	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99						1	1	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99						1	1	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	2	2	0	0			
St. Oswalds, Gloucester	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99	1						1	1	0	-	-	0
	38.00-40.99	1					1	2	1	0	-	-	0
	41.00-43.99					1		1	0	1	-	-	200
	44.00-46.99							0	0	0			
	Total	2	0	0	0	1	1	4	2	1	-	-	50
Staple Gardens	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99	1						1	1	0	-	-	0
	41.00-43.99	1				1		2	1	1	-	-	100
	44.00-46.99		1					1	1	0	-	-	0
	Total	2	1	0	0	1	0	4	3	1	-	-	33
Medieval Sites													
Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Chichester	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99	1			1		1	3	1	1	-	-	100
	41.00-43.99	2				1		3	2	1	-	-	50
	44.00-46.99				1			1	0	1	-	-	200
	Total	3	0	0	2	1	1	7	3	3	-	-	100

Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Cirencester Abbey	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99				1			1	0	1	-	-	200
	Total	0	0	0	1	0	0	1	0	1	-	-	200
Clopton	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99				1			1	0	1	-	-	200
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	1	0	0	1	0	1	-	-	200
Comet Place	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99					1	1	2	0	1	-	-	200
	41.00-43.99							0	0	0			
	44.00-46.99	1					1	2	1	0	-	-	0
	Total	1	0	0	0	1	2	4	1	1	-	-	100
Cuddington	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99					1		1	0	1	-	-	200
	35.00-37.99							0	0	0			
	38.00-40.99			1		1		2	0	1	-	-	200
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	1	0	2	0	3	0	2	-	-	200
East Smithfield	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99	1						1	1	0	-	-	0
	35.00-37.99	1						1	1	0	-	-	0
	38.00-40.99	2	1	1	1			5	3	1	-	-	33
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	4	1	1	1	0	0	7	5	1	-	-	20
Eynsham Abbey	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Gloucester Blackfriars	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99	1						1	1	0	-	-	0
	41.00-43.99					1		1	0	1	-	-	200
	44.00-46.99							0	0	0			
	Total	1	0	0	0	1	0	2	1	1	-	-	100

Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Guildhall Yard	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99	2						2	2	0	-	-	0
	Total	2	0	0	0	0	0	2	2	0	-	-	0
Hereford Cathedral	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99	1				1	1	3	1	1	-	-	100
	32.00-34.99	1						1	1	0	-	-	0
	35.00-37.99		1					1	1	0	-	-	0
	38.00-40.99	1	1			1	1	4	2	1	-	-	50
	41.00-43.99	2						2	2	0	-	-	0
	44.00-46.99	1			1	1		3	1	2	-	-	200
	Total	6	2	0	1	3	2	14	8	4	1.33	0.248	50
Huntington Orchard Lane	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Leominster	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99		1					1	1	0	-	-	0
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	1	0	0	0	0	1	1	0	-	-	0
Market Street, Winchester	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
New Romney	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	0	0	0	0			
Spital Square	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99	1						1	1	0	-	-	0
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	1	0	0	0	0	0	1	1	0	-	-	0

Site Name	Gestational Age (weeks)	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
St Benet Sherehog	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99				1			1	0	1	-	-	200
	35.00-37.99							0	0	0			
	38.00-40.99					1		1	0	1	-	-	200
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	1	1	0	2	0	2	-	-	200
St Gregory's Priory Canterbury	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99							0	0	0			
	41.00-43.99						1	1	0	0			
	44.00-46.99							0	0	0			
	Total	0	0	0	0	0	1	1	0	0			
St Nicholas Shambles	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99		1					1	1	0	-	-	0
	41.00-43.99							0	0	0			
	44.00-46.99		1					1	1	0	-	-	0
	Total	0	2	0	0	0	0	2	2	0	-	-	0
St. John Clerkenwell	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99	1						1	1	0	-	-	0
	41.00-43.99							0	0	0			
	44.00-46.99							0	0	0			
	Total	1	0	0	0	0	0	1	1	0	-	-	0
St. Mary Graces	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99							0	0	0			
	32.00-34.99							0	0	0			
	35.00-37.99							0	0	0			
	38.00-40.99	1						1	1	0	-	-	0
	41.00-43.99	1						1	1	0	-	-	0
	44.00-46.99							0	0	0			
	Total	2	0	0	0	0	0	2	2	0	-	-	0
St. Oswalds, Gloucester	23.00-25.99		1					1	1	0	-	-	0
	26.00-28.99							0	0	0			
	29.00-31.99	1				1	1	3	1	1	-	-	100
	32.00-34.99	1						1	1	0	-	-	0
	35.00-37.99	3	1					4	4	0	-	-	0
	38.00-40.99	2	1		1	4	3	11	3	5	-	-	167
	41.00-43.99	1			1		3	5	1	1	-	-	100
	44.00-46.99		2		1	1		4	2	2	-	-	100
	Total	8	5	0	3	6	7	29	13	9	0.73	0.394	69
Stonar	23.00-25.99							0	0	0			
	26.00-28.99							0	0	0			
	29.00-31.99	2						2	2	0	-	-	0
	32.00-34.99	1			1			2	1	1	-	-	100
	35.00-37.99	2		1				3	2	0	-	-	0
	38.00-40.99	1					1	2	1	0	-	-	0
	41.00-43.99	1	1	1	3			6	2	3	-	-	150
	44.00-46.99		1			2	2	5	1	2	-	-	200
	Total	7	2	2	4	2	3	20	9	6	0.6	0.439	67

Appendix 4: Modern Mortality Rate Ratio of Infants under 27 Days (Data source: United Nations 2007: Table 16).

Country	Age	Male	Female	Mortality Rate Ratio of Infants Under 27 Days
Australia 2007	Under 27 Days	3.16	**2.85**	110.57
Azerbaijan 2007	Under 27 Days	5.51	4.39	125.60
Canada 2005	Under 27 Days	4.37	3.85	113.45
Chile 2006	Under 27 Days	5.85	4.92	118.96
France 2006	Under 27 Days	2.68	1.98	134.81
Germany 2007	Under 27 Days	2.95	2.36	125.04
Guatemala 2006	Under 27 Days	12.40	9.77	126.94
Italy 2005	Under 27 Days	2.94	2.49	117.93
Japan 2007	Under 27 Days	1.36	1.26	107.94
Kazakhstan 2007	Under 27 Days	10.35	7.17	144.26
Kyrgyzstan 2007	Under 27 Days	22.79	19.23	118.49
Malaysia 2004	Under 27 Days	4.17	3.20	130.52
Pakistan 2005	Under 27 Days	55.28	40.54	136.34
Philippines 2005	Under 27 Days	8.51	6.18	137.72
Poland 2007	Under 27 Days	4.74	3.87	122.60
Romania 2007	Under 27 Days	7.71	5.98	128.89
Russian Federation 2007	Under 27 Days	6.19	4.59	134.92
Spain 2007	Under 27 Days	2.37	2.16	109.94
Ukraine 2007	Under 27 Days	7.68	5.52	139.17
United Kingdom 2003	Under 27 Days	3.86	3.40	113.45
United States of America 2003	Under 27 Days	5.08	4.14	122.84
Uzbekistan 2000	Under 27 Days	8.99	6.35	141.59
			Mean	125.54
			Standard Deviation	10.93
			Range	114.62-136.47

Appendix 5: Age and Sex Distribution of Individuals by Site

Early Anglo-Saxon Sites

Site Name	Age	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Alton, Mount Pleasant	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	1	1	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	1	0	0	1	0	0	2	1	1	-	-	100
	2-3 Year Child	0	1	0	0	0	0	1	1	0	-	-	0
	3-4 Year Child	0	0	0	0	0	1	1	0	0			
	4-5 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	1	0	1	1	2	6	2	2	-	-	100
Barrington Edix Hill	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	1	0	0	0	0	1	1	0	-	-	0
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	Total	0	1	0	0	1	0	2	1	1	-	-	100
Beacon Hill	Foetus	0	0	1	0	0	0	1	0	0			
	Neonate	0	0	0	1	0	0	1	0	1	-	-	
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	1	1	0	0	2	0	1	-	-	
Bradstow School, Broadstairs	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	2	2	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	3	3	0	0			
	4-5 Year Child	0	0	0	1	0	0	1	0	1	-	-	
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	1	0	5	6	0	1	-	-	
Burwell	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	1	0	0	1	0	1	-	-	
	4-5 Year Child	0	0	0	1	1	0	2	0	2	-	-	
	5-6 Year Child	1	0	0	0	0	0	1	1	0	-	-	0
	Total	1	0	0	2	1	0	4	1	3	-	-	300
Cannington	Foetus	1	1	0	1	1	9	13	2	2	-	-	100
	Neonate	1	1	0	2	0	3	7	2	2	-	-	100
	Infant	1	4	0	3	1	3	12	5	4	-	-	80
	1-2 Year Child	2	2	1	5	6	2	18	4	11	3.27	0.071	275
	2-3 Year Child	0	2	0	2	0	7	11	2	2	-	-	100
	3-4 Year Child	0	1	1	2	2	2	8	1	4	-	-	400
	4-5 Year Child	0	1	2	0	2	1	6	1	2	-	-	200
	5-6 Year Child	0	0	0	0	0	1	1	0	0			
	Total	5	12	4	15	12	28	76	17	27	2.27	0.132	159

Site Name	Age	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Dover Buckland	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	1	0	0	1	0	1	-	-	
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	3	3	0	0			
	2-3 Year Child	0	0	0	0	0	1	1	0	0			
	3-4 Year Child	0	0	0	0	0	2	2	0	0			
	4-5 Year Child	0	0	0	0	0	3	3	0	0			
	5-6 Year Child	0	0	0	0	0	3	3	0	0			
	Total	0	0	0	1	0	12	13	0	1	-	-	
Droxford	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	1	0	0	0	1	0	0			
	5-6 Year Child	0	0	0	0	0	1	1	0	0			
	Total	0	0	1	0	0	1	2	0	0			
Eccles	Foetus	0	0	0	0	1	1	2	0	1	-	-	
	Neonate	0	0	0	1	0	0	1	0	1	-	-	
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	1	1	1	3	0	2	-	-	
Finglesham	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	1	1	0	0			
	1-2 Year Child	0	1	0	1	1	1	4	1	2	-	-	200
	2-3 Year Child	0	0	0	0	0	1	1	0	0			
	3-4 Year Child	0	0	0	0	1	1	2	0	1	-	-	
	4-5 Year Child	0	0	1	0	0	1	2	0	0			
	5-6 Year Child	0	0	0	0	1	4	5	0	1	-	-	
	Total	0	1	1	1	3	9	15	1	4	-	-	400
Great Chesterford	Foetus	3	0	2	6	2	35	48	3	8	2.27	0.132	267
	Neonate	4	6	1	1	1	9	22	10	2	5.33	0.021*	20
	Infant	0	0	0	1	2	0	3	0	3	-	-	
	1-2 Year Child	1	0	0	0	1	2	4	1	1	-	-	100
	2-3 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	3-4 Year Child	0	0	0	2	2	2	6	0	4	-	-	
	4-5 Year Child	0	0	0	1	1	0	2	0	2	-	-	
	5-6 Year Child	0	0	0	1	1	0	2	0	2	-	-	
	Total	8	6	3	12	11	48	88	14	23	2.19	0.139	164
Henley Wood	Foetus	3	0	0	0	0	1	4	3	0	-	-	0
	Neonate	1	0	0	0	0	0	1	1	0	-	-	0
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	4	0	0	0	0	1	5	4	0	-	-	0
Holborough	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	1	0	1	2	0	1	-	-	
	Total	0	0	0	1	0	1	2	0	1	-	-	

Site Name	Age	F	F?	I	M ?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Lechlade Butler's Field	Foetus	1	0	1	0	0	0	2	1	0	-	-	0
	Neonate	1	0	0	0	0	1	2	1	0	-	-	0
	Infant	1	1	0	2	0	0	4	2	2	-	-	100
	1-2 Year Child	3	4	0	4	2	1	14	7	6	0.08	0.782	86
	2-3 Year Child	1	0	0	0	2	0	3	1	2	-	-	200
	3-4 Year Child	1	0	0	0	1	0	2	1	1	-	-	100
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	8	5	1	6	5	2	27	13	11	0.17	0.683	85
New Wintles	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	1	0	0	1	0	1	-	-	
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	1	0	0	1	0	1	-	-	
Portway East	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	1	0	0	0	0	2	3	1	0	-	-	0
	2-3 Year Child	0	0	0	1	0	0	1	0	1	-	-	
	3-4 Year Child	0	0	0	0	0	1	1	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	0	0	1	0	3	5	1	1	-	-	100
Queenford Farm	Foetus	0	0	0	1	0	0	1	0	1	-	-	
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	1	1	0	0	0	0	2	2	0	-	-	0
	1-2 Year Child	3	0	0	2	1	0	6	3	3	-	-	100
	2-3 Year Child	1	1	0	0	2	3	7	2	2	-	-	100
	3-4 Year Child	3	2	0	0	0	1	6	5	0	-	-	0
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	8	4	0	3	3	4	22	12	6	2.00	0.157	50
Redcastle Furze	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	3	3	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	0	0	3	3	0	0			
Stanton Harcourt	Foetus	0	0	0	0	0	1	1	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	1	0	2	3	0	1	-	-	
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	1	0	3	4	0	1	-	-	
Station Road, Gamlingay	Foetus	1	1	0	1	0	2	5	2	1	-	-	50
	Neonate	0	0	0	0	0	3	3	0	0			
	Infant	1	0	0	0	0	1	2	1	0	-	-	0
	1-2 Year Child	1	0	0	1	2	4	8	1	3	-	-	300
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	1	0	0	1	0	1	-	-	
	4-5 Year Child	0	0	0	0	0	1	1	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	3	1	0	3	2	11	20	4	5	-	-	125

Site Name	Age	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Watchfield	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	1	1	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	0	0	1	1	0	0			
Winnall	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	3-4 Year Child	0	0	0	1	1	0	2	0	2	-	-	
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	1	2	0	3	0	3	-	-	
Worthy Park	Foetus	0	0	0	0	0	1	1	0	0			
	Neonate	1	0	0	0	0	0	1	1	0	-	-	0
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	2	0	2	4	0	2	-	-	
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	1	1	0	0			
	5-6 Year Child	1	0	0	0	0	0	1	1	0	-	-	0
	Total	2	0	0	2	0	4	8	2	2	-	-	100
Late Anglo-Saxon Sites													
Site Name	Age	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Cherry Hinton	Foetus	6	6	3	5	3	21	44	12	8	0.80	0.371	67
	Neonate	0	2	2	10	4	9	27	2	14	9.00	0.003**	700
	Infant	3	0	1	9	7	6	26	3	16	8.90	0.003**	533
	1-2 Year Child	3	2	1	12	8	5	31	5	20	9.00	0.003**	400
	2-3 Year Child	0	1	0	6	6	6	19	1	12	9.31	0.002**	1200
	3-4 Year Child	3	6	5	4	8	4	30	9	12	0.43	0.513	133
	4-5 Year Child	0	2	0	7	6	1	16	2	13	8.07	0.005**	650
	5-6 Year Child	0	4	0	1	2	1	8	4	3	-	-	75
	Total	15	23	12	54	44	53	201	38	98	26.47	0.000***	258
Cirencester Abbey	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	1	0	0	0	0	0	1	1	0	-	-	0
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	0	0	0	0	0	1	1	0	-	-	0

Site Name	Age	F	F?	I	M ?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Norwich North-East Bailey	Foetus	2	0	1	0	1	0	4	2	1	-	-	50
	Neonate	2	0	0	1	0	0	3	2	1	-	-	50
	Infant	2	1	0	0	1	2	6	3	1	-	-	33
	1-2 Year Child	2	0	0	1	0	3	6	2	1	-	-	50
	2-3 Year Child	3	1	0	0	1	1	6	4	1	-	-	25
	3-4 Year Child	2	0	0	0	1	5	8	2	1	-	-	50
	4-5 Year Child	1	1	0	1	0	1	4	2	1	-	-	50
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	14	3	1	3	4	12	37	17	7	4.17	0.041*	41
Nunnaminster	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	1	0	0	0	1	0	0			
	1-2 Year Child	1	0	0	0	0	0	1	1	0	-	-	0
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	0	1	0	0	0	2	1	0	-	-	0
Raunds	Foetus	13	2	0	2	2	0	19	15	4	6.37	0.012*	27
	Neonate	5	2	0	1	7	3	18	7	8	0.07	0.796	114
	Infant	4	2	0	2	6	0	14	6	8	0.29	0.593	133
	1-2 Year Child	3	2	2	3	8	1	19	5	11	2.25	0.134	220
	2-3 Year Child	2	0	1	0	5	0	8	2	5	-	-	250
	3-4 Year Child	0	1	1	0	5	1	8	1	5	-	-	500
	4-5 Year Child	0	0	0	1	7	1	9	0	8	-	-	
	5-6 Year Child	0	1	0	2	1	0	4	1	3	-	-	300
	Total	27	10	4	11	41	6	99	37	52	2.53	0.112	141
Romsey Abbey	Foetus	0	0	0	0	0	1	1	0	0			
	Neonate	0	0	0	0	0	1	1	0	0			
	Infant	1	0	0	0	0	2	3	1	0	-	-	0
	1-2 Year Child	0	0	0	0	0	3	3	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	0	0	0	0	7	8	1	0	-	-	0
St. Oswalds, Gloucester	Foetus	2	0	0	0	0	1	3	2	0	-	-	0
	Neonate	0	0	0	0	1	0	1	0	1	-	-	
	Infant	1	1	0	0	1	2	5	2	1	-	-	50
	1-2 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	2-3 Year Child	1	0	0	0	0	0	1	1	0	-	-	0
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	4	1	0	0	3	3	11	5	3	-	-	60
Staple Gardens	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	2	1	0	0	1	0	4	3	1	-	-	33
	Infant	2	1	0	1	0	1	5	3	1	-	-	33
	1-2 Year Child	3	2	0	0	0	0	5	5	0	-	-	0
	2-3 Year Child	1	0	0	0	5	2	8	1	5	-	-	500
	3-4 Year Child	0	1	0	1	2	0	4	1	3	-	-	300
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	8	5	0	2	8	3	26	13	10	0.39	0.532	77

Medieval Sites

Site Name	Age	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Chichester	Foetus	1	0	0	1	0	1	3	1	1	-	-	100
	Neonate	2	0	0	1	1	0	4	2	2	-	-	100
	Infant	4	1	0	0	2	4	11	5	2	-	-	40
	1-2 Year Child	2	0	1	2	2	3	10	2	4	-	-	200
	2-3 Year Child	3	0	1	0	2	2	8	3	2	-	-	67
	3-4 Year Child	0	2	0	3	3	1	9	2	6	-	-	300
	4-5 Year Child	1	1	0	1	3	1	7	2	4	-	-	200
	5-6 Year Child	1	0	0	0	3	1	5	1	3	-	-	300
	Total	14	4	2	8	16	13	57	18	24	0.86	0.355	133
Cirencester Abbey	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	1	0	0	1	0	1	-	-	
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	1	0	0	0	0	0	1	1	0	-	-	0
	3-4 Year Child	1	0	0	1	0	0	2	1	1	-	-	100
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	1	0	0	0	0	0	1	1	0	-	-	0
	Total	3	0	0	2	0	0	5	3	2	-	-	67
Clopton	Foetus	0	0	0	1	0	0	1	0	1	-	-	
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	2	0	0	2	0	2	-	-	
	3-4 Year Child	1	0	0	2	1	0	4	1	3	-	-	300
	4-5 Year Child	0	2	0	1	0	0	3	2	1	-	-	50
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	2	0	6	1	0	10	3	7	1.60	0.206	233
Comet Place	Foetus	0	0	0	0	0	1	1	0	0			
	Neonate	1	0	0	0	1	1	3	1	1	-	-	100
	Infant	1	0	0	0	2	1	4	1	2	-	-	200
	1-2 Year Child	0	1	0	1	2	1	5	1	3	-	-	300
	2-3 Year Child	1	1	0	0	1	2	5	2	1	-	-	50
	3-4 Year Child	1	0	0	2	1	1	5	1	3	-	-	300
	4-5 Year Child	0	1	0	1	2	0	4	1	3	-	-	300
	5-6 Year Child	0	0	1	0	0	0	1	0	0			
	Total	4	3	1	4	9	7	28	7	13	1.80	0.180	186
Cuddington	Foetus	0	0	0	0	2	0	2	0	2	-	-	
	Neonate	0	0	1	0	0	0	1	0	0			
	Infant	0	1	0	0	0	1	2	1	0	-	-	0
	1-2 Year Child	2	0	0	1	2	0	5	2	3	-	-	150
	2-3 Year Child	1	0	0	2	0	0	3	1	2	-	-	200
	3-4 Year Child	0	1	0	1	1	1	4	1	2	-	-	200
	4-5 Year Child	1	1	0	0	0	0	2	2	0	-	-	0
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	4	3	1	4	5	2	19	7	9	0.25	0.617	129
East Smithfield	Foetus	4	0	1	1	0	0	6	4	1	-	-	25
	Neonate	1	1	0	0	0	0	2	2	0	-	-	0
	Infant	0	1	0	0	0	1	2	1	0	-	-	0
	1-2 Year Child	2	1	2	1	4	0	10	3	5	-	-	167
	2-3 Year Child	1	1	0	2	1	0	5	2	3	-	-	150
	3-4 Year Child	1	2	1	1	3	0	8	3	4	-	-	133
	4-5 Year Child	2	0	0	2	4	0	8	2	6	-	-	300
	5-6 Year Child	3	0	0	0	2	0	5	3	2	-	-	67
	Total	14	6	4	7	14	1	46	20	21	0.02	0.876	105

Site Name	Age	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
Eynsham Abbey	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	1	0	0	1	0	1	-	-	
	2-3 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	3-4 Year Child	0	1	0	0	1	0	2	1	1	-	-	100
	4-5 Year Child	0	0	0	1	0	0	1	0	1	-	-	
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	1	0	2	2	0	5	1	4	-	-	400
Gloucester Blackfriars	Foetus	1	0	0	0	0	0	1	1	0	-	-	0
	Neonate	0	0	0	0	1	0	1	0	1	-	-	
	Infant	2	0	0	0	1	0	3	2	1	-	-	50
	1-2 Year Child	2	0	0	0	0	0	2	2	0	-	-	0
	2-3 Year Child	0	0	0	2	1	2	5	0	3	-	-	
	3-4 Year Child	0	1	0	1	2	0	4	1	3	-	-	300
	4-5 Year Child	0	0	0	2	2	1	5	0	4	-	-	
	5-6 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	Total	5	1	0	5	8	3	22	6	13	2.58	0.108	217
Guildhall Yard	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	2	0	0	0	0	0	2	2	0	-	-	0
	Infant	0	0	0	0	1	0	1	0	1	-	-	
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	1	0	0	1	0	0	2	1	1	-	-	100
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	3	0	0	1	1	0	5	3	2	-	-	67
Hereford Cathedral	Foetus	3	2	0	0	2	2	9	5	2	-	-	40
	Neonate	3	0	0	1	2	3	9	3	3	-	-	100
	Infant	1	1	0	1	0	2	5	2	1	-	-	50
	1-2 Year Child	4	2	0	1	3	1	11	6	4	0.40	0.527	67
	2-3 Year Child	2	1	0	0	3	2	8	3	3	-	-	100
	3-4 Year Child	0	3	1	2	2	2	10	3	4	-	-	133
	4-5 Year Child	5	1	0	0	4	0	10	6	4	0.40	0.527	67
	5-6 Year Child	0	3	0	2	1	1	7	3	3	-	-	100
	Total	18	13	1	7	17	13	69	31	24	0.89	0.345	77
Huntington Orchard Lane	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	1	1	0	0			
	1-2 Year Child	1	0	0	1	0	0	2	1	1	-	-	100
	2-3 Year Child	0	0	0	0	0	1	1	0	0			
	3-4 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	0	0	1	1	2	5	1	2	-	-	200
Leominster	Foetus	0	1	0	0	0	0	1	1	0	-	-	0
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	1	0	0	0	0	1	1	0	-	-	0
Market Street, Winchester	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	2-3 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	0	2	0	2	0	2	-	-	

Site Name	Age	F	F?	I	M?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
New Romney	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	1	1	0	0			
	1-2 Year Child	1	0	0	1	2	1	5	1	3	-	-	300
	2-3 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	0	0	1	3	2	7	1	4	-	-	400
Spital Square	Foetus	1	0	0	0	0	0	1	1	0	-	-	0
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	1	0	0	0	0	0	1	1	0	-	-	0
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	1	0	0	1	0	2	1	1	-	-	100
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	2	1	0	0	1	0	4	3	1	-	-	33
St Benet Sherehog	Foetus	0	0	0	1	1	0	2	0	2	-	-	
	Neonate	0	0	0	0	0	0	0	0	0			
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	1	1	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	0	0	0	1	1	1	3	0	2	-	-	
St Gregory's Priory Canterbury	Foetus	0	0	0	0	0	0	0	0	0			
	Neonate	0	0	0	0	0	1	1	0	0			
	Infant	0	0	0	0	1	0	1	0	1	-	-	
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	1	2	3	0	1	-	-	
	3-4 Year Child	0	0	0	0	0	1	1	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	1	0	0	0	0	1	1	0	-	-	0
	Total	0	1	0	0	2	4	7	1	2	-	-	200
St Nicholas Shambles	Foetus	0	1	0	0	0	0	1	1	0	-	-	0
	Neonate	0	1	0	0	0	0	1	1	0	-	-	0
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	1	0	0	2	1	0	4	1	3	-	-	300
	2-3 Year Child	0	0	0	1	0	0	1	0	1	-	-	
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	1	2	0	3	1	0	7	3	4	-	-	133
St. John Clerkenwell	Foetus	1	0	0	0	0	0	1	1	0	-	-	0
	Neonate	1	0	0	0	0	0	1	1	0	-	-	0
	Infant	0	0	0	0	0	0	0	0	0			
	1-2 Year Child	0	0	0	0	0	0	0	0	0			
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	0	0	0	0	0	0	0	0			
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	2	0	0	0	0	0	2	2	0	-	-	0
St. Mary Graces	Foetus	1	0	0	0	0	0	1	1	0	-	-	0
	Neonate	1	0	0	0	0	0	1	1	0	-	-	0
	Infant	0	0	0	1	0	0	1	0	1	-	-	
	1-2 Year Child	2	1	0	1	0	1	5	3	1	-	-	33
	2-3 Year Child	0	1	0	0	1	1	3	1	1	-	-	100
	3-4 Year Child	0	0	0	1	0	1	2	0	1	-	-	
	4-5 Year Child	2	0	0	2	2	0	6	2	4	-	-	200
	5-6 Year Child	0	0	0	0	1	0	1	0	1	-	-	
	Total	6	2	0	5	4	3	20	8	9	0.06	0.808	113

Site Name	Age	F	F?	I	M ?	M	U	Total	Total Number of Females	Total Number of Males	χ^2	P=	Mortality Rate Ratio
St. Oswalds, Gloucester	Foetus	6	3	0	1	4	2	16	9	5	1.14	0.285	56
	Neonate	3	2	0	2	2	5	14	5	4	-	-	80
	Infant	1	0	0	1	0	1	3	1	1	-	-	100
	1-2 Year Child	2	0	0	0	0	0	2	2	0	-	-	0
	2-3 Year Child	0	0	0	0	0	0	0	0	0			
	3-4 Year Child	0	1	0	0	1	0	2	1	1	-	-	100
	4-5 Year Child	0	0	0	0	0	0	0	0	0			
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	12	6	0	4	7	8	37	18	11	1.69	0.194	61
Stonar	Foetus	5	0	1	1	0	1	8	5	1	-	-	20
	Neonate	2	3	1	3	2	2	13	5	5	0.00	1.000	100
	Infant	0	0	0	1	0	3	4	0	1	-	-	
	1-2 Year Child	0	0	0	1	2	2	5	0	3	-	-	
	2-3 Year Child	3	0	0	1	1	0	5	3	2	-	-	67
	3-4 Year Child	1	0	0	0	1	2	4	1	1	-	-	100
	4-5 Year Child	0	0	0	1	3	1	5	0	4	-	-	
	5-6 Year Child	0	0	0	0	0	0	0	0	0			
	Total	11	3	2	8	9	11	44	14	17	0.29	0.590	121

Appendix 6: Modern Mortality Rate Ratio of Infants Aged 28 Days to One Year (Data source: United Nations 2007: Table 16).

Country	Age	Male	Female	Mortality Rate Ratio of Individuals Aged 28 Days to 1 Year
Argentina 2006	28 days – 1 year	4.72	4.12	114.63
Australia 2007	28 days – 1 year	1.33	1.11	120.13
Azerbaijan 2007	28 days – 1 year	6.27	6.90	90.78
Canada 2005	28 days – 1 year	1.50	1.14	131.65
Chile 2006	28 days – 1 year	5.27	4.51	116.97
Egypt 2007	28 days – 1 year	9.77	9.68	100.96
France 2006	28 days – 1 year	1.42	1.19	119.03
Germany 2007	28 days – 1 year	1.37	1.06	128.97
Guatemala 2006	28 days – 1 year	14.38	12.47	115.27
Italy 2005	28 days – 1 year	1.15	1.01	114.44
Japan 2007	28 days – 1 year	1.38	1.18	116.81
Kazakhstan 2007	28 days – 1 year	6.22	4.99	124.65
Kyrgyzstan 2007	28 days – 1 year	11.02	7.96	138.32
Malaysia 2004	28 days – 1 year	3.06	2.52	121.32
Pakistan 2005	28 days – 1 year	29.48	27.03	109.07
Philippines 2005	28 days – 1 year	6.01	4.82	124.63
Poland 2007	28 days – 1 year	1.81	1.53	118.23
Republic of Korea 2006	28 days – 1 year	1.72	1.50	114.72
Romania 2007	28 days – 1 year	5.65	4.55	124.27
Russian Federation 2007	28 days – 1 year	4.18	3.42	122.21
Spain 2007	28 days – 1 year	1.29	1.07	121.18
Ukraine 2007	28 days – 1 year	4.81	3.85	125.08
United Kingdom 2003	28 days – 1 year	1.83	1.49	123.17
United States of America 2003	28 days – 1 year	2.52	1.94	129.89
Uzbekistan 2000	28 days – 1 year	12.41	10.37	119.65
Venezuela 2001	28 days – 1 year	5.17	4.24	122.11
			Mean	119.54
			Standard Deviation	9.43
			Range	110.11-128.97

Appendix 7: Modern Mortality Rate Ratio of Infants Aged One to Four Years (Data source: United Nations 2007: Table 19).

Country	Age	Male	Female	Mortality Rate Ratio of Individuals Aged 1-4 years
Albania 2004	1 - 4 years	1.25	1.07	116.35
Armenia 2007	1 - 4 years	0.45	0.41	111.93
Australia 2007	1 - 4 years	0.26	0.16	161.90
Austria 2007	1 - 4 years	0.19	0.15	122.85
Azerbaijan 2007	1 - 4 years	1.29	1.02	126.79
Bahamas 2007	1 - 4 years	0.26	0.27	94.81
Belarus 2007	1 - 4 years	0.82	0.57	143.58
Bhutan 2005	1 - 4 years	5.63	5.07	111.05
Botswana 2001	1 - 4 years	8.29	7.24	114.37
Bulgaria 2007	1 - 4 years	0.53	0.47	113.92
Canada 2005	1 - 4 years	0.24	0.17	145.14
Chile 2006	1 - 4 years	0.41	0.29	139.12
China, Hong Kong SAR 2006	1 - 4 years	0.25	0.17	148.88
Croatia 2007	1 - 4 years	0.26	0.16	160.03
Cuba 2007	1 - 4 years	0.32	0.31	103.97
Cyprus 2007	1 - 4 years	0.06	0.19	31.49
Czech Republic 2007	1 - 4 years	0.24	0.17	136.19
Denmark 2007	1 - 4 years	0.22	0.18	120.29
El Salvador 2007	1 - 4 years	0.69	0.57	122.07
Estonia 2007	1 - 4 years	0.42	0.22	188.88
Finland 2007	1 - 4 years	0.22	0.18	124.63
France 2005	1 - 4 years	0.21	0.18	118.06
Germany 2007	1 - 4 years	0.21	0.18	115.21
Greece 2007	1 - 4 years	0.20	0.15	131.98
Guadeloupe 2003	1 - 4 years	0.34	0.29	117.42
Hungary 2007	1 - 4 years	0.30	0.26	118.13
Iceland 2007	1 - 4 years	0.23	0.47	48.37
Israel 2007	1 - 4 years	0.28	0.23	119.47
Italy 2004	1 - 4 years	0.18	0.17	106.13
Kazakhstan 2007	1 - 4 years	1.12	1.01	110.53
Kyrgyzstan 2007	1 - 4 years	1.30	1.31	98.75
Latvia 2007	1 - 4 years	0.51	0.27	189.90
Lithuania 2007	1 - 4 years	0.39	0.25	152.42
Luxembourg 2007	1 - 4 years	0.43	0.37	115.44
Macedonia 2007	1 - 4 years	0.28	0.36	76.56
Malawi 1998	1 - 4 years	51.19	41.65	122.93
Maldives 2007	1 - 4 years	0.46	0.48	95.00
Mauritius 2007	1 - 4 years	0.47	0.35	133.83
Mexico 2007	1 - 4 years	0.81	0.71	115.02
Mongolia 2007	1 - 4 years	1.69	1.53	110.69
Montenegro 2007	1 - 4 years	0.31	0.33	91.98
Nepal 2001	1 - 4 years	4.89	3.76	130.07
Netherlands 2007	1 - 4 years	0.21	0.16	129.35
New Caledonia 2007	1 - 4 years	1.08	0.25	423.50
Norway 2007	1 - 4 years	0.14	0.18	81.46
Poland 2007	1 - 4 years	0.29	0.22	130.02
Portugal 2007	1 - 4 years	0.21	0.18	118.73
Puerto Rico 2006	1 - 4 years	0.19	0.25	76.60
Qatar 2007	1 - 4 years	0.78	0.15	502.31
Republic of Moldova 2007	1 - 4 years	0.66	0.53	124.27
Romania 2007	1 - 4 years	0.62	0.48	128.66
Russian Federation 2007	1 - 4 years	0.70	0.52	135.90
Serbia 2007	1 - 4 years	0.31	0.21	145.86
Slovakia 2007	1 - 4 years	0.36	0.35	102.75
Slovenia 2007	1 - 4 years	0.27	0.23	118.49
Spain 2007	1 - 4 years	0.22	0.20	107.24
Suriname 2007	1 - 4 years	1.00	1.05	94.80
Sweden 2007	1 - 4 years	0.14	0.19	70.69
Switzerland 2007	1 - 4 years	0.15	0.18	87.05
Ukraine 2007	1 - 4 years	0.74	0.63	117.97

Country	Age	Male	Female	Mortality Rate Ratio of Individuals Aged 1-4 years
United Kingdom 2005	1 - 4 years	0.24	0.20	120.18
United States of America 2005	1 - 4 years	0.33	0.25	132.78
Uruguay 2002	1 - 4 years	0.63	0.33	188.76
Uzbekistan 2000	1 - 4 years	2.45	2.19	111.51
Venezuela 2002	1 - 4 years	0.95	0.79	119.84
Zimbabwe 2002	1 - 4 years	13.01	11.30	115.13
			Mean	129.39
			Standard Deviation	65.88
			Range	63.51-195.28

Appendix 8: Modern Mortality Rate Ratio of Infants Aged Five to Nine Years (Data source: United Nations 2007: Table 19).

Country	Age	Male	Female	Mortality Rate Ratio of Individuals Aged 5-9 Years
Albania 2004	5 - 9 years	0.75	0.41	181.49
Argentina 2007	5 - 9 years	0.26	0.21	124.52
Armenia 2007	5 - 9 years	0.18	0.16	110.79
Australia 2007	5 - 9 years	0.09	0.08	110.66
Austria 2007	5 - 9 years	0.10	0.06	173.92
Azerbaijan 2007	5 - 9 years	0.39	0.37	106.47
Bahamas 2007	5 - 9 years	0.49	0.28	172.55
Bahrain 2007	5 - 9 years	0.19	0.22	83.48
Belarus 2007	5 - 9 years	0.28	0.20	136.34
Bhutan 2005	5 - 9 years	2.39	1.55	154.33
Botswana 2001	5 - 9 years	2.41	2.24	107.76
Brunei Darussalam 2007	5 - 9 years	0.37	0.31	119.26
Bulgaria 2007	5 - 9 years	0.26	0.22	118.93
Canada 2005	5 - 9 years	0.12	0.08	146.86
Chile 2006	5 - 9 years	0.20	0.14	143.60
China, Hong Kong SAR 2006	5 - 9 years	0.12	0.08	155.88
Costa Rica 2006	5 - 9 years	0.26	0.20	130.22
Croatia 2007	5 - 9 years	0.14	0.15	89.65
Cuba 2007	5 - 9 years	0.23	0.14	170.46
Cyprus 2007	5 - 9 years	0.27	0.23	114.96
Czech Republic 2007	5 - 9 years	0.11	0.09	129.19
Denmark 2007	5 - 9 years	0.09	0.07	127.41
El Salvador 2007	5 - 9 years	0.29	0.23	127.32
Estonia 2007	5 - 9 years	0.22	0.13	164.14
Finland 2007	5 - 9 years	0.09	0.11	82.90
France 2005	5 - 9 years	0.11	0.08	133.87
Georgia 2007	5 - 9 years	0.19	0.18	108.36
Germany 2007	5 - 9 years	0.11	0.07	160.75
Greece 2007	5 - 9 years	0.14	0.10	130.29
Guadeloupe 2003	5 - 9 years	0.23	0.06	384.07
Hungary 2007	5 - 9 years	0.13	0.13	101.45
Iceland 2007	5 - 9 years	0.09	0.10	97.80
Ireland 2007	5 - 9 years	0.10	0.06	159.33
Israel 2007	5 - 9 years	0.13	0.13	99.44
Italy 2004	5 - 9 years	0.11	0.08	125.39
Japan 2007	5 - 9 years	0.10	0.08	125.38
Kazakhstan 2007	5 - 9 years	0.54	0.37	143.57
Kuwait 2007	5 - 9 years	0.33	0.25	130.63
Kyrgyzstan 2007	5 - 9 years	0.39	0.29	133.12
Latvia 2007	5 - 9 years	0.35	0.19	181.60
Lithuania 2007	5 - 9 years	0.29	0.21	138.43
Macedonia 2007	5 - 9 years	0.14	0.18	76.66
Malawi 1998	5 - 9 years	12.87	10.36	124.22
Malaysia 2006	5 - 9 years	0.25	0.22	116.48
Maldives 2007	5 - 9 years	0.33	0.28	117.62
Malta 2007	5 - 9 years	0.09	0.09	96.45
Martinique 2007	5 - 9 years	0.21	0.07	290.43
Mauritius 2007	5 - 9 years	0.22	0.15	150.93
Mexico 2007	5 - 9 years	0.29	0.25	116.97
Mongolia 2007	5 - 9 years	0.59	0.39	151.03
Montenegro 2007	5 - 9 years	0.38	0.21	186.06
Namibia 2001	5 - 9 years	3.79	3.57	106.01
Nepal 2001	5 - 9 years	1.06	1.01	104.65
Netherlands 2007	5 - 9 years	0.09	0.09	95.70
Netherlands Antilles 2006	5 - 9 years	0.28	0.14	197.41
New Caledonia 2007	5 - 9 years	0.35	0.09	381.53
New Zealand 2007	5 - 9 years	0.16	0.09	176.46
Norway 2007	5 - 9 years	0.07	0.08	79.56
Pakistan 2005	5 - 9 years	1.15	1.04	109.95
Philippines 2005	5 - 9 years	0.61	0.49	125.38

Country	Age	Male	Female	Mortality Rate Ratio of Individuals Aged 5-9 Years
Poland 2007	5 - 9 years	0.15	0.11	141.01
Portugal 2007	5 - 9 years	0.14	0.09	161.11
Puerto Rico 2006	5 - 9 years	0.08	0.07	114.83
Qatar 2007	5 - 9 years	0.19	0.30	63.27
Republic of Moldova 2007	5 - 9 years	0.36	0.17	213.78
Romania 2007	5 - 9 years	0.34	0.25	136.46
Russian Federation 2007	5 - 9 years	0.40	0.27	148.62
Saint Lucia 2005	5 - 9 years	0.13	0.13	100.08
Serbia 2007	5 - 9 years	0.16	0.14	114.58
Singapore 2007	5 - 9 years	0.13	0.10	128.07
Slovakia 2007	5 - 9 years	0.21	0.23	91.94
Slovenia 2007	5 - 9 years	0.09	0.14	62.46
Spain 2007	5 - 9 years	0.12	0.10	120.30
Suriname 2007	5 - 9 years	0.35	0.28	123.27
Sweden 2007	5 - 9 years	0.08	0.09	90.18
Switzerland 2007	5 - 9 years	0.11	0.08	131.76
Ukraine 2007	5 - 9 years	0.45	0.26	169.71
United Kingdom 2005	5 - 9 years	0.10	0.09	118.15
United States of America 2005	5 - 9 years	0.16	0.13	116.02
Uruguay 2002	5 - 9 years	0.22	0.24	92.73
Uzbekistan 2000	5 - 9 years	0.53	0.37	144.74
Venezuela 2002	5 - 9 years	0.35	0.25	140.69
Zimbabwe 2002	5 - 9 years	3.65	3.08	118.44
			Mean	135.93
			Standard Deviation	52.31
			Range	83.62-188.24

Appendix 9: Pathological Descriptions

Site Name	Burial Number	Skeleton Number	Pathology
Alton, Mount Pleasant		28	Possible linear cut in right orbital plate, there is some remodelling with rough new bone on the superior portion of the cut and rounded margins inferiorly on the internal surface the cut area bulbs outwards into the eye socket.
Bradstow School, Broadstairs		20	Active cribra orbitalia in the left orbit (right not present).
Burwell	B137	EU 1.2.114	Left femur shows possible medial-lateral bending of diaphysis.
Cannington	6	6	Bilateral cribra orbitalia, left orbit also has new bone formation towards the medial border.
Cannington	29	29	Bilateral periostitis on the anterior medial surface of the tibiae.
Cannington	70	70	Woven bone on the exterior surface of the mandibular ramus on both left and right side.
Cannington	138	138	Endocranial lesions on the frontal. Bilateral periosteal reaction on the anterior medial surface of the tibiae.
Cannington	160	160	Bilateral moderate cribra orbitalia
Cannington	171	171	Bilateral moderate cribra orbitalia. Porosity on the ectocranial surface of the greater wing of the sphenoid
Cannington	175	175	Bilateral moderate cribra orbitalia. Endocranial lesion; woven bone on the superior surface of the lesser wing and around the foramens of the sphenoid. Bilateral mild porosity on the ectocranial surface of the parietals. Increased porosity on the ectocranial surface of the mandible. Porosity on the ectocranial surface of the maxilla. Increased porosity on the superior and posterior surfaces of the right scapula (left not present).
Cannington	180	180	Bilateral moderate cribra orbitalia. Porosity on the ectocranial surface of the right temporal. Porotic hyperostosis on both parietals
Cannington	186	186	Bilateral periosteal reaction on the anterior medial surface of the tibiae.
Cannington	275	275	Bilateral moderate cribra orbitalia
Cannington	278	278	Cribra orbitalia in right orbit (left not present)
Cannington	298	298	Bilateral moderate cribra orbitalia.
Cannington	304	304	Active severe cribra orbitalia in left orbit (right not present). Porosity on the ectocranial surface of the greater wing of the sphenoid. Porosity and new bone formation on the ectocranial surface of the parietals
Cannington	309	309	Bilateral periosteal reaction on the lateral anterior surface of the tibiae.
Cannington	324	324	Cribra orbitalia in the left orbit.
Cannington	344	344	Endocranial lesions on the occipital.
Cannington	349	349	Endocranial lesions on the occipital and parietals.
Cannington	354	354	Endocranial lesions on the occipital and parietals.
Cannington	386	386	Endocranial lesions on the parietals.
Cannington	418	418	Endocranial lesions on the parietals and the frontals. Porosity on the ectocranial surface of the greater wing of the sphenoid. Woven bone on the mandibular ramus. Periosteal bone reaction on the anterior medial surface of the right tibia (left not present).
Cannington	437	437	Bilateral active cribra orbitalia
Cannington	438	438	Active cribra orbitalia in the left orbit (right not present). Porosity on the ectocranial surface of the greater wing of the sphenoid.
Cannington	404a	618	Bilateral cribra orbitalia. Extensive woven bone on the endocranial surface of the frontal. Periosteal reaction on the anterior medial surface of the left tibia and the anterior surface of the right femur.
Cannington	504+	620	Cribra orbitalia in the right orbit (left not present). Porosity on the superior surface of the greater wing of the sphenoid.
Eccles		006(t)	Bilateral cribra orbitalia.
Great Chesterford		31	Bilateral mild cribra orbitalia. Porosity and woven bone with striations on the anterior medial and posterior surface of the left tibia. Striations and mild porosity on medial surface of right tibia midshaft.
Great Chesterford		34	Porous woven bone on the superior surface of sphenoid around the foramen. Porosity on ectocranial surface of parietal. Bilateral porous new bone formation on the distal medial and posterior surface of the tibiae, anterior and posterior surfaces of the femora , on the lateral surface of the fibulae, anterior surface of the ulnae around foramen , anterior surface of the radii. Porous new bone formation on the endocranial surface and around vertebral facets / vertebral end of the left ribs. Porous woven bone on the posterior surface of the right scapular (left fragmentary). Possible right bifid rib.
Great Chesterford		42	Cribra orbitalia in the left orbit (right fragmentary). Porosity in the

Site Name	Burial	Skeleton	Pathology
			supraspinous fossa of left scapular (right not present).
Great Chesterford		56	Woven bone with vascular tracks on the superior surface of the left zygoma. Stumpy appearance of limb bones, possible flaring of distal metaphysis of left radius (right not present) possible flared sternal end of ribs with increased vascularisation.
Great Chesterford		57	Cribra orbitalia in the right orbit (left not present). Porosity in the supraspinous fossa of the left scapular (right not present).
Great Chesterford		67	Enlarged metaphysis of distal radius, sternal end of ribs enlarged
Great Chesterford		70	Bilateral periosteal reaction on the anterior medial surface of tibiae.
Great Chesterford		77	Bilateral periosteal reaction on the anterior medial surface of the tibiae.
Great Chesterford		78	Bilateral periosteal reaction on the anterior medial surface of the tibiae.
Great Chesterford		99	Bilateral active cribra orbitalia, enlarged foramen on the left parietal.
Great Chesterford		106	Moderate cribra orbitalia in the left orbit. Endocranial lesions - small areas of new bone formation with vascular impressions on parietals, occipitals, frontal and temporals. Compact bone on the superior surface of both zygomas. Porosity on the ectocranial surface of the greater wing of the sphenoid, woven bone with vascular impressions on the superior surface of the greater wings of the sphenoid. Woven bone in the nasal aperture of maxilla. Periosteal reaction with extensive porous and striated woven bone visible on most bones: bilateral humeri on distal third, both femora on most of diaphysis but most severe on the posterior surface, on diaphysis of fibula, medial inferior surface of right clavicle (not on left), bilateral on first metatarsals around the foramen, inferior and lateral surfaces of metacarpals, inferior surface of phalanges. Extensive woven bone on the endocranial surface of the right ribs. Plaque of woven bone on the anterior surface of the right scapular also has porosity in the supraspinous fossa.
Great Chesterford		107	Cribra orbitalia in right orbit (left not present).
Great Chesterford		139	Bilateral periosteal reaction on the lateral medial surface of the tibiae
Great Chesterford		143	Extensive cribra orbitalia in right orbit (left not present). Woven bone on the endocranial surface of the occipital. Remodelled lesions on the endocranial surface of the parietals. Porosity on the ectocranial surface of parietal fragment.
Great Chesterford		148	Bilateral moderate cribra orbitalia.
Great Chesterford		150	Bilateral periosteal reaction on the posterior surface of the ulnae and radii and the distal posterior and anterior surface of the humeri.
Great Chesterford		156	Endocranial lesions - woven bone on the endocranial surface of frontal and on the superior surface of the greater wing of the sphenoid, increased vascularisation on the endocranial surface of the parietals. Bilateral periosteal reaction on the anterior medial surface of the tibiae. Extensive porous woven bone on the left clavicle visible on the humeral end but probably covered much of the diaphysis.
Great Chesterford		158	Porosity on the anterior medial surface of left tibia (right not present). Bilateral porosity on femora on the proximal meal surface just below the head.
Henley Wood		22	Endocranial lesion on the basiliar portion.
Lechlade Butler's Field	42	13	Endocranial lesions on both parietals.
Lechlade Butler's Field	130	53	Cribra orbitalia in right orbit (left fragmentary). Porotic hyperostosis on both parietals.
Lechlade Butler's Field	1052	110	Cribra orbitalia in left orbit (right fragmented).
Lechlade Butler's Field	1068	122	Endocranial lesions on the occipital.
Lechlade Butler's Field	1080	129	New bone formation on endocranial surface of the occipital. Possible anterior-posterior bending of tibial shafts.
Lechlade Butler's Field	1098	141	Patches of new bone growth on the lateral surface of the mandible.
Lechlade Butler's Field	1214	198	Plaque of new bone formation on the anterior surface of the right femur.
Queenford Farm		5	Endocranial lesions on parietals. Porotic hyperostosis on parietals.
Queenford Farm		63	Endocranial lesions on left frontal.
Queenford Farm		97	New bone formation plaques on endocranial surface of left temporal & sphenoid.
Queenford Farm		127	Endocranial lesions on frontal.
Queenford Farm		128	Endocranial lesions on occipital.
Queenford Farm		F74	Cribra orbitalia in the right orbit.
Redcastle Furze		964	Endocranial lesion on the occipital.
Redcastle Furze		1172	Woven bone on the endocranial surface of occipital. Periosteal reaction on the right femur.

Site Name	Burial	Skeleton	Pathology
Station Road, Gamlingay		2012	Periosteal reaction on the left tibia.
Station Road, Gamlingay		2121	Bilateral moderate cribra orbitalia.
Station Road, Gamlingay		2125	Porosity on the ectocranial surface of the greater wing of the sphenoid.
Station Road, Gamlingay		2288	Porotic hyperostosis on the parietals and occipital. Periosteal reaction on right humerus.
Station Road, Gamlingay		2298	Endocranial lesions on the frontal.
Station Road, Gamlingay		2334	Endocranial lesions on cranial fragments.
Station Road, Gamlingay		2346	Mild endocranial lesion on occipital. Bilateral periosteal reaction on the medial posterior surface of the tibiae. The distal metaphysis of both femurs is grossly enlarged, bilateral anterior posterior bending of the femoral shafts. Left humerus (right not present) has periosteal reaction on posterior surface, proximal metaphysis is enlarged, medial/lateral bending of the shaft, and general stumpy appearance. The right radius (left not present) shows medial/lateral bending of distal shaft.
Station Road, Gamlingay		2420	Woven bone on the endocranial surface of occipital. Periosteal reaction on the limb bones but poorly preserved. Periosteal reaction on the anterior and posterior surfaces of the right clavicle (left fragmentary). Periosteal reaction on the anterior, posterior and in the supraspinous fossae of both scapulae.
Station Road, Gamlingay		2436	Cribra orbitalia in the right orbit (left fragmentary).
Winnall		18	Cribra orbitalia in the left orbit (right fragmentary).
Worthy Park		4	Active cribra orbitalia in left orbit (right not present).
Cherry Hinton	32	2123s	Bilateral cribra orbitalia. Porous woven bone on the superior surface of the wings of the sphenoid.
Cherry Hinton	43	2157s	Cribra orbitalia in the left orbit (right not present).
Cherry Hinton	48	2176s	Cribra orbitalia in right orbit (left not present). Porosity superior to the external auditory meatus of the left temporal (not on right).
Cherry Hinton	60	2214s	Periosteal reaction on the anterior surface of both femora, the anterior medial surface of the right tibia, and the posterior surface of the right humerus.
Cherry Hinton	67	2247s	Cribra orbitalia in right orbit (left not present).
Cherry Hinton	69	2253s	Cribra orbitalia.
Cherry Hinton	94	2338s	Bilateral active cribra orbitalia. Woven bone on the superior surface of the sphenoid. Woven bone on the endocranial surface of the occipital. Woven bone on the superior surface of the maxillae. Bilateral porosity superior to the external auditory meatus. Porosity on the ectocranial surface of the greater wing of the sphenoid.
Cherry Hinton	97	2345s	Bilateral moderate cribra orbitalia.
Cherry Hinton	113	2395s	Bilateral moderate cribra orbitalia. Faint endocranial lesions on the occipital, frontal and parietals almost completely remodelled. Bilateral porosity superior to the external auditory meatus.
Cherry Hinton	138	2468s	Bilateral mild cribra orbitalia. Porosity and woven bone on the endocranial surface of the occipital. Woven bone on the endocranial surface of the frontal.
Cherry Hinton	171	2604s	Bilateral cribra orbitalia. Endocranial lesions: porous woven bone one the occipital, parietals and frontals. Porotic hyperostosis on parietals.
Cherry Hinton	178	2627s	Periosteal reaction on the posterior surface of the left ilium (right not present).
Cherry Hinton	184	2647s	Bilateral cribra orbitalia. Woven bone and porosity on the endocranial surface of the occipital and the parietals.
Cherry Hinton		2871/2	Periosteal reaction on the anterior surface of the right humerus.
Cherry Hinton		2871/3 a	Woven bone on the endocranial surface of an occipital fragment.
Cherry Hinton		2871/3 b	Woven bone on the endocranial surface of an occipital fragment.
Cherry Hinton		2871u	Bilateral active cribra orbitalia
Cherry Hinton	211	2990s	Woven bone and porosity on the endocranial surface of the occipital. Porosity on the ectocranial surface of the greater wing of the sphenoid. Woven bone on the anterior lateral surface of the right femur proximal fragment. Porosity on the superior surface of the right scapula.
Cherry Hinton		2997f (2999s)	Bilateral mild cribra orbitalia. Woven bone on the endocranial surface of the occipital.
Cherry Hinton	220	3017s	Endocranial lesion on the cruciate eminence of the occipital.
Cherry Hinton	244	3088s	Bilateral moderate cribra orbitalia.
Cherry Hinton	247	3097s	Bilateral moderate cribra orbitalia. Bilateral periosteal reaction on the anterior medial surface of tibiae
Cherry Hinton	250	3106s	Cribra orbitalia in left orbit (not in right).
Cherry Hinton	308	3279s	Porosity on the ectocranial surface of the greater wing of the sphenoid.

Site Name	Burial	Skeleton	Pathology
Cherry Hinton	324	3332s	Mild bilateral cribra orbitalia. Woven bone on the superior surface of the lesser wings of the sphenoid.
Cherry Hinton		3413 FD	Woven bone on the endocranial surface of the occipital around the cruciate eminence. Porous woven bone around the foramen on the superior surface of the great wing of the sphenoid.
Cherry Hinton	385	3534s	Bilateral active cribra orbitalia. Endocranial lesions on the occipital.
Cherry Hinton	389	3546s	Bilateral cribra orbitalia. Porotic hyperostosis on the ectocranial surface of parietal fragments.
Cherry Hinton	392	3555s b	Porosity and vascular impressions on the endocranial surface of cranial fragments.
Cherry Hinton	420	3639s	Bilateral moderate cribra orbitalia. Bilateral porosity superior to the external auditory meatus. Possible pathological mandible with the premature eruption of the left first permanent molar, mandible itself appears distorted.
Cherry Hinton	422	3645s	Bilateral cribra orbitalia. Porosity on the endocranial surface of the occipital. Porosity in the supraspinous fossa of the scapulae.
Cherry Hinton	435	3685s	Cribra orbitalia in the left orbit.
Cherry Hinton	448	3726s	Bilateral cribra orbitalia with evidence of remodelling. Endocranial lesions on parietal fragments. Porosity on the ectocranial surface of the greater wing of the sphenoid. Porosity superior to the external auditory meatus.
Cherry Hinton	458	3756s	Extensive cribra orbitalia in right orbit (left not present). Woven bone on the endocranial surface of the occipital. Remodelled lesions on the endocranial surface of the parietals. Porosity on the ectocranial surface of parietal fragment.
Cherry Hinton	503	3904L	Vascularised woven bone on the endocranial surface of the parietals.
Cherry Hinton	506	3913L	Cribra orbitalia in right orbit (left not present).
Cherry Hinton	512	3932s	Periosteal reaction on the posterior distal surface of the left humerus (right fragmented).
Cherry Hinton	514	3938s	Porosity on the endocranial surface of the occipital.
Cherry Hinton	516	3944s	Bilateral woven bone in the supraspinous fossae of scapulae.
Cherry Hinton	518	3950s	Bilateral moderate cribra orbitalia.
Cherry Hinton	525	3970L	Bilateral periosteal reaction on the anterior medial surface of the tibiae.
Cherry Hinton	528	3978s	Periosteal reaction on the long bones, particularly the anterior surface of the right tibia.
Cherry Hinton	538	4008u	Bilateral cribra orbitalia. Porosity on the endocranial surface of the occipital.
Cherry Hinton	552	4071s	Bilateral mild cribra orbitalia. Porosity on the superior surface of the lesser wings of the sphenoid
Cherry Hinton	557	4083s	Cribra orbitalia in left orbit (right fragmentary).
Cherry Hinton	565	4107s	Woven bone on the endocranial surface of the occipital and other cranial fragments.
Cherry Hinton	586	4176s	Endocranial lesions on the frontal.
Cherry Hinton	599	4222L (4223s)	Active cribra orbitalia in right orbit. Porosity superior to the external auditory meatus. Bilateral porosity on the anterior medial surface of the tibiae.
Cherry Hinton	599	4223s	Bilateral cribra orbitalia. Right mandibular canine and lateral incisor fused together
Cherry Hinton	601	4229s	Bilateral periosteal reaction on tibiae and on posterior of ilia.
Cherry Hinton	606	4246s	Bilateral active moderate cribra orbitalia. Endocranial lesions on the parietals, porosity on the endocranial surface of the occipital. Bilateral porosity superior to the external auditory meatus. Porosity on the ectocranial surface of the greater wing of the sphenoid. Porosity on the anterior surface of maxilla. Woven bone on the anterior surface of the left maxilla superior to the first molar.
Cherry Hinton	607	4249s	Porosity in the supraspinous fossa of the left scapular.
Cherry Hinton	610	4258s	Porosity on the ectocranial surface of the greater wing of the sphenoid.
Cherry Hinton	636	4342u	Cribra orbitalia in the right orbit (left fragmentary). Woven bone on the endocranial surface of the occipital.
Cherry Hinton		5458/4	Cribra orbitalia in the left orbit (right not present).
Cherry Hinton		5629/1 a	Cranial fragment with endocranial lesions.
Cirencester Abbey	P VII 1	H141	There is severe new bone growth on the exterior surface of the cranium bones with the occipital fragments showing layers of new bone over the cortical bone. Periosteal reaction on the long bone shafts. The femurs which due to preservation have lost much of the external layers of new bone this is evidenced by the rough surface of the cortical bone which has attachment areas from the lost new bone growth. The matrix is very light in weight; it lacks normal density and is very fragile.
Norwich North-East Bailey	1366 (1)	139	Cribra orbitalia in the left orbit (right not present).
Norwich North-East Bailey	1366 (2)	139	Bilateral cribra orbitalia. Also enlarged porosity on ectocranial surface of frontal - could be due to closure of metopic suture.

Site Name	Burial	Skeleton	Pathology
Norwich North-East Bailey	1366 (3)	139	Bilateral cribra orbitalia.
Norwich North-East Bailey	2078	243	Bilateral cribra orbitalia. New bone formation on endocranial surface of cranial bones - occipital, parietals, frontal.
Norwich North-East Bailey	2145	244	New bone formation around foramen on superior surface of scapula.
Norwich North-East Bailey	2113	247	Endocranial lesions on frontal bone and basioccipital.
Norwich North-East Bailey	2094	249	Cribra orbitalia in right orbit (left not present)
Norwich North-East Bailey	1095	255	Bilateral active cribra orbitalia.
Norwich North-East Bailey	2202	259	Bilateral cribra orbitalia.
Norwich North-East Bailey	2192	272	Bilateral cribra orbitalia. Endocranial lesions on temporal squama. Porosity on anterior surface of maxilla.
Norwich North-East Bailey	1171	274	Healed new bone formation on greater wing of sphenoid.
Norwich North-East Bailey	1018 A		New bone formation on endocranial surface of left parietal.
Raunds		5005	Bilateral mild cribra orbitalia. Periosteal new bone formation on the anterior medial surface of both tibiae. Plaque of compact bone on the anterior distal surface of both femora. Right clavicle has porous surface on the anterior side of the sternal end. Sphenoid has double foramen, and also the small wings have unusual pseudo-joints interiorly.
Raunds		5011	Plaque of woven bone on the medial posterior border of the right tibia (left not present).
Raunds		5012	Bilateral cribra orbitalia with vascular impressions. Bilateral porosity above the external auditory meatus (left with signs of woven bone). Bilateral woven bone in the temporo-mandibular fossa. Porosity on the ectocranial surface of the greater wing of sphenoid. Plaque of woven bone on the anterior medial distal surface of left tibia.
Raunds		5023	Cribra orbitalia in right orbit (left fragmentary). Woven bone in foramen of sphenoid.
Raunds		5032	Bilateral moderate cribra orbitalia
Raunds		5034	Bilateral cribra orbitalia. Woven bone on the superior surface of the sphenoid. Vascular impressions on the endocranial surface of the parietals. New bone formation on the ectocranial surface of the cranial bones. Periosteal new bone formation on the anterior and distal surface on both humeri.
Raunds		5038	Hair-end appearance to endocranial lesions on the occipital but with extensive remodelling. Porosity on the ectocranial surface of the greater wing of the sphenoid.
Raunds		5057	Endocranial lesions with vascular impressions on cranial fragments and porosity on the superior surface of the sphenoid. Woven bone on ectocranial surface of cranial fragments. Periosteal new bone reaction on limb bones.
Raunds		5079	Periosteal new bone formation on the right tibia (left not present).
Raunds		5082	Enthesophyte on the distal anterior medial border of left humerus (not on right).
Raunds		5083	Woven bone on the posterior surface of distal right humerus (left not present). Woven bone on the posterior of the midshaft of the left femur (not present on right femur). Plaque of woven bone on the proximal anterior lateral border of the right femur (not on the left)
Raunds		5088	Bilateral moderate cribra orbitalia.
Raunds		5096	Woven bone with striations on the anterior medial surface of both tibiae. Flaring of the metaphysis of the distal right femur (the left is broken). Limb bones have stumpy appearance.
Raunds		5101	Endocranial lesions with woven bone on the occipital and compact bone in the saddle of the sphenoid. Woven bone on the posterior left humerus. Woven bone on the anterior surface of both femora. Extensive woven bone on the anterior medial surface of both tibiae. Upper limb bones have stumpy appearance.
Raunds		5109	Bilateral cribra orbitalia. Compact bone on the posterior medial surface of both tibiae (more prominent on left).
Raunds		5135	Bilateral cribra orbitalia
Raunds		5140	Endocranial lesions on the parietals, occipital and sphenoid.
Raunds		5141	Periosteal bone reaction on the limb bones.
Raunds		5143	Endocranial lesions on the sphenoid and left temporal. Woven bone on the gonion region of the mandible. Periosteal reaction on one rib. Bilateral periosteal reaction on the humeri, femora and tibia, and on the posterior

Site Name	Burial	Skeleton	Pathology
			surface of the ilia. Flaring of the distal radius.
Raunds		5165	Porosity of the ectocranial surface of the greater wing of the sphenoid. New bone formation in the right orbit. Periosteal reaction on the anterior medial and posterior surface of the right tibia (left not present). Remodelled periosteal reaction on the anterior surface of left femur.
Raunds		5169	Bilateral cribra orbitalia also left orbit has enlarged tract running from the foramen. Porosity of ectocranial surface of the greater wings of sphenoid. Remodelled periosteal reaction on the left femur (right fragmentary). Periosteal reaction on the anterior medial surface of the right tibia. Periosteal reaction on the anterior and posterior surfaces of both humeri. Periosteal reaction on right ulna (left fragmentary).
Raunds		5170	Bilateral moderate cribra orbitalia. Porosity on the ectocranial surface of the greater wing of the sphenoid. Bilateral periosteal reaction on the posterior surface of femora and anterior surface of tibiae.
Raunds		5174	Compact bone on the anterior surface of the right tibia (left fragmented). Linear hypoplasia visible on the upper incisors (right medial and left lateral).
Raunds		5177	Cribra orbitalia in the right orbit (not in left). New bone formation on the superior surface of the greater wing of the sphenoid. Compact bone above the external auditory meatus on the right temporal (not on left).
Raunds		5185	Bilateral active cribra orbitalia.
Raunds		5189	Periosteal bone reaction on the anterior medial surface of the left tibia (right not present).
Raunds		5191	Endocranial lesions on the occipital, woven bone with some remodelling.
Raunds		5194	Bilateral cribra orbitalia.
Raunds		5196	Mild periosteal new bone reaction on the right anterior lateral proximal femur and the right anterior medial tibia.
Raunds		5198	Periosteal bone reaction on the anterior and posterior surface left humerus (right not present). Bilateral periosteal reaction on the posterior lateral surface of tibiae. Woven bone on the superior surface of the left scapula.
Raunds		5208	Very mild almost completely remodelled cribra orbitalia visible in the left orbit (right fragmentary). Bilateral mild periosteal reaction on the anterior medial surface of the tibiae (both striations and pitting visible).
Raunds		5210	Bilateral mild cribra orbitalia (mostly remodelled) smooth compact bone visible in left orbit. Porosity on the ectocranial surface of the greater wing of the sphenoid. Possible bilateral anterior/posterior bending of the femora and tibiae. Enlarged metaphysis of distal femora.
Raunds		5212	Bilateral moderate active cribra orbitalia. Bilateral porosity superior to the external auditory meatus. Porosity on the greater wing of sphenoid. The right pas lateralis has a sub oval hole posterior to the articular surface with rounded margins (probably misshapen foramen).
Raunds		5233	Endocranial lesions on the occipital. Bilateral periosteal reaction on the medial posterior surface of tibiae, and on the posterior surface of the ilia.
Raunds		5238	Mild cribra orbitalia of the left orbit (right not present). Endocranial lesions on the parietals and occipital: hair on end lesions with frosted appearance indicative of healing.
Raunds		5244	Woven bone on the superior surface of the greater wings of the sphenoid. Woven bone on the endocranial surface of the occipital. Bilateral periosteal reaction on tibiae.
Raunds		5258	Bilateral mild cribra orbitalia.
Raunds		5259	Periosteal bone reaction on the long bones and on the posterior surface of the right ilium (left not present).
Raunds		5264	Endocranial lesions on cranial fragments.
Raunds		5267	Periosteal bone reaction on the anterior medial surface of the right tibia (left fragmentary).
Raunds		5269	Endocranial lesions on cranial fragments. Periosteal bone reaction on the posterior surface of the left humerus.
Raunds		5273	Mild cribra orbitalia in the left orbit (right not present). Woven bone around the foramen of the sphenoid.
Raunds		5274	Bilateral cribra orbitalia.
Raunds		5275	Bilateral cribra orbitalia. The sphenoid fragments display a bone that is abnormally enlarged/thickened with periosteal bone reaction visible on the greater wings. Bilateral periosteal bone formation on the anterior medial and posterior surfaces of the tibiae, on the posterior surface of the ilia, on the humeri, radii and ulnae. Periosteal bone formation on the anterior surface of the right femur, and on the anterior and posterior surfaces of the right scapula.
Raunds		5276	Woven bone on endocranial surface of cranial fragment. Most of the cranial bones display increased porosity/vascularisation on both the ecto and endocranial surfaces. Periosteal bone reaction on the anterior medial surface of the right tibia (left fragmented). Periosteal bone reaction on the posterior

Site Name	Burial	Skeleton	Pathology
			surface of the left ilium (right fragmented) the anterior surface as an area of increased vascularisation. Periosteal bone reaction on the anterior distal surface of the right humerus (left fragmented).
Raunds		5277	Endocranial lesions on cranial fragments.
Raunds		5279	Bilateral cribra orbitalia. Endocranial lesions on the parietals.
Raunds		5280	Bilateral mild cribra orbitalia. The greater wings of the sphenoid are abnormally thick with the superior surface uneven, the ectocranial surface displays pitting. Bilateral periosteal reaction on the anterior medial surface of tibiae mostly remodelled but some striations and pitting visible in the compact bone.
Raunds		5300	Bilateral cribra orbitalia. Endocranial lesion on the parietal. Periosteal bone reaction on tibial fragment. Porosity in the supraspinous fossa of the left scapular (right fragmented).
Raunds		5301	Endocranial lesions on cranial fragment. The left temporal is possibly malformed due to lytic lesions to the posterior of the endocranial surface. Bilateral periosteal reaction on the lateral surface and the anterior distal surface of the femurs.
Raunds		5302	Endocranial lesion on the occipital, compact bone indicating healing.
Raunds		5304	Cribra orbitalia in left orbit (right not present). Porosity on the ectocranial surface of the greater wing of sphenoid.
Raunds		5305	Endocranial lesions on the parietals.
Raunds		5307	Cribra orbitalia in the left orbit (right not present). Endocranial lesions on the frontal and porosity on the superior surface of the sphenoid. Porosity on the superior surface of the right scapula (left fragmented).
Raunds		5309	Bilateral cribra orbitalia. Porosity on the endocranial surface of the occipital. Bilateral porous compact bone on the anterior medial surface of the tibiae.
Raunds		5310	Bilateral active moderate cribra orbitalia. Woven bone on the endocranial surface of the parietal. Porosity on the ectocranial surface of the greater wing of the sphenoid. Bilateral porous compact bone on the anterior medial surface of the tibiae.
Raunds		5312	Bilateral active cribra orbitalia. Endocranial lesions on the occipital, parietals and frontal. Woven bone on the anterior surface of the frontal. Porosity on the ectocranial surface of the greater wing of sphenoid. Porosity on the ectocranial surface of the temporal. Porosity on the superior surface of the right scapula (left not present).
Raunds		5320	Bilateral porous compact bone on the anterior medial surface of tibiae.
Raunds		5334	Bilateral moderate cribra orbitalia. Endocranial lesion on cranial fragment
Raunds		5336	Bilateral cribra orbitalia. Porosity on the endocranial surface of the occipital.
Raunds		5339	Bilateral cribra orbitalia. New bone formation on the endocranial surface of the frontal. Periosteal reaction on the posterior surface of the right humerus.
Raunds		5340	Endocranial lesions - porous woven bone on the occipital. Compact bone with some vascular impressions on the frontal. Bilateral periosteal reaction on the tibiae. Bilateral periosteal reaction on the posterior surface of the ilia. Limb bones have stumpy appearance.
Raunds		5345	Bilateral moderate cribra orbitalia. Porosity above the left external auditory meatus (right not present). Endocranial lesions on the parietals and occipital with lots of remodelling. Bilateral porosity on the superior surface of scapulas.
Raunds		5346	Endocranial lesions with woven bone on the frontal, occipital, parietals and temporals. Bilateral porosity superior to the external auditory meatus. Bilateral periosteal reaction on the anterior surface of tibiae.
Raunds		5349	Bilateral cribra orbitalia
Raunds		5354	Woven bone on the superior surface of the sphenoid around the foramen. Bilateral porosity superior to the external auditory meatus.
Raunds		5355	Compact bone on the superior surface of sphenoid. Bilateral woven bone on the anterior medial surface of the humeri and compact bone on the posterior distal surface of the humeri. Bilateral porosity in the supraspinous fossae of the scapulae.
Staple Gardens	223	850	Cribra orbitalia in left orbit - medium severity with signs of remodelling,
Staple Gardens	224	853	Bilateral cribra orbitalia.
Staple Gardens	267	971	New bone formation on the endocranial surface of the mandibular ramus.
Staple Gardens	302	987	Bilateral cribra orbitalia with signs of remodelling,
Staple Gardens	295	1048	Bilateral cribra orbitalia with signs of remodelling.
Staple Gardens	330	1130	Bilateral active cribra orbitalia. Linear enamel hypoplasia on permanent teeth. Possible congenital absence of deciduous mandibular canine.
Staple Gardens	384	1298	Possible slight bend midshaft of left tibia, with possible clocca on anterior medial surface.
Staple Gardens	1087	2241	Active cribra orbitalia in right orbit - left not present.
Chichester		69	Cribra orbitalia in the right orbit (left fragmentary).
Chichester		80	Bilateral active cribra orbitalia. New bone growth on the endocranial surface of

Site Name	Burial	Skeleton	Pathology
			the occipital, parietals and frontal. Bilateral periosteal reaction on the anterior surface of the tibiae.
Chichester		86	Bilateral cribra orbitalia with extensive remodelling.
Chichester		105	Bilateral cribra orbitalia. Endocranial lesions on frontal and parietals (severe on right parietal - very active).
Chichester		107	Endocranial lesions on most cranial elements.
Chichester		112	Small patch of porous compact bone on the distally medial anterior surface of the left tibia.
Chichester		114	Bilateral active cribra orbitalia.
Chichester		121	Mild cribra orbitalia of the right orbit with some remodelling (left orbit not present). All the right ribs present - four right ribs have new bone formation on the endocranial surface; 8th rib has some small woven bone on the endocranial surface of the rib with no remodelling visible. The 9th rib has large deposit on new bone formation on the endocranial surface including both woven and compact bone. The 10th rib has large deposits of both woven and compact bone but also large lytic lesion with scalloped edge cutting through the new bone and appearing to start to affect the cortical bone of the rib. The 11th rib has a large deposit of new bone on the endocranial surface both woven and compact bone present. (The 10 left ribs present are all normal). (Unfortunately only cranium, ribs and vertebra present with the long bones having been lost during curation as the original context sheet describes most long bones present with extensive periosteal reaction).
Chichester		132	Endocranial lesions: porosity on the occipital with extensive remodelling shown in presence of compact bone. Extensively remodelled vascularisation (very faint) on the parietals. Pit on frontal (could just be large arachnoid granulation).
Chichester		140	Bilateral medial-lateral bending of tibiae & twisting of femurs (rickets).
Chichester		152	Bilateral moderate cribra orbitalia. Two patches of porosity on the endocranial surface of the frontal. Bilateral porosity and plaques of woven bone superior to the external auditory meatus of the temporals.
Chichester		159	Bilateral active cribra orbitalia. Endocranial lesion on endocranial surface of the occipital. Periosteal reaction on medial-anterior surface of the left tibia.
Chichester		173	Bilateral moderate cribra orbitalia. Porosity and new bone formation superior to the left external auditory meatus. Bilateral porosity on the anterior medial surface of the tibia.
Chichester		180	Plaques of new bone formation on the endocranial surface of the right parietal.
Chichester		188	Bilateral mild cribra orbitalia.
Chichester		213	Endocranial lesions on occipital and parietals.
Chichester		221	Bilateral moderate cribra orbitalia.
Chichester		224	Small plaque of new bone growth on endocranial surface of parietal. Small plaques of new bone formation on both internal and ectocranial surfaces of occipital. New bone formation on sphenoid. New bone formation on mandible. Enlarged foramen rotundum on the right portion of the sphenoid.
Chichester		231	Some vacuolisation on the endocranial surface of the parietals. Two cranial fragments have porotic hyperostosis on the ectocranial surface.
Chichester		232	Woven bone in nasal aperture of the maxillae following track of the nasolacrimal duct - although seen bilaterally there is more woven bone present on the right maxilla.
Chichester		266	Bilateral cribra orbitalia. Remodelled woven bone on the endocranial surface of the frontal and parietals. Porous woven bone on the ectocranial surface of parietals (porotic hyperostosis). Compact bone in the subarcutate fossa of left temporal (not present in right). Woven bone on the anterior surface of the tibiae. Woven bone on the humerus. The ulna is much wider than normal giving a stumpy appearance.
Chichester		270	Endocranial lesions on the parietals. Porotic hyperostosis on the ectocranial surface of the frontal and parietals.
Chichester		302	Bilateral mild cribra orbitalia.
Chichester		303	New bone formation on the ectocranial surface of occipital.
Chichester		320	Bilateral moderate cribra orbitalia. Some vascular impressions on the endocranial surface of the parietals extensive remodelling. The ectocranial surface of the parietals shows striations running laterally medially. Bilateral porosity superior to the external auditory meatus. Right ribs all present the 5th and 6th ribs have small plaques of new bone formation on the endocranial surface this being more prominent on the sixth rib (left ribs all present and all normal). There is a plaque of woven bone on the anterior lateral surface of the distal left humerus. Plaque of woven bone with striation on the anterior medial distal surface of both tibiae. Plaque of woven bone on both femora on the posterior distal surface.
Chichester		321	Endocranial lesions including porous woven bone on the occipital at the cruciate eminence. Vascular impressions on the parietals and frontal. Frontal

Site Name	Burial	Skeleton	Pathology
			has woven bone with vascular impressions on the ectocranial surface. Porosity around the foramen in the supraspinous fossa of the left scapular.
Chichester		322	Bilateral cribra orbitalia. Woven bone on the gonion region of the mandible. Endocranial lesions on the occipital and frontal. Porous woven bone on the ectocranial surface of parietals and occipital. Bilateral periosteal reaction on the anterior surface of the femora, the anterior and posterior surface of both tibiae, posterior surface of both scapulars and on the posterior surface of both ilia. Periosteal reaction is also present on the upper limb bones but these are poorly preserved.
Chichester		323	Endocranial lesions with vascularisation in frontals and parietals. Woven bone on the ectocranial surface of parietals and frontals. Woven bone on the posterior distal surface of the right humerus (the left not present). Woven bone on the anterior lateral surface of both femora.
Chichester		324	Cribra orbitalia. Some vascular impressions on the endocranial surface of parietal. New bone formation in the nasolacrimal duct of both maxillae. Woven bone on the sphenoid in the area between the two foramen superiorly. One lumbar vertebral body (the only one present) appears to be missing the superior aspect of the anterior border this doesn't seems to be taphonomic and could be pathological or trauma.
Chichester		67b	Bilateral cribra orbitalia.
Cirencester Abbey	PI 24 SK4	H138	Bilateral cribra orbitalia.
Comet Place	CAM 0005		Bilateral cribra orbitalia. Endocranial lesions on the occipital bone. Pitting of maxilla palate possible rounding of nasal aperture margin but likely this is just highlighted by taphonomic damage and subsequent loss of medial incisors.
Cuddington	C VII 4	14	New bone formation on the endocranial surface of the temporals. Woven bone on the sphenoid both lesser and greater wings particularly focused around the foramen. Porotic hyperostosis on the ectocranial surface of the parietals.
Cuddington	C II 7	99	Active cribra orbitalia in left orbit (right is fragmented).
East Smithfield		5345	Cribra orbitalia in the left orbit.
East Smithfield		7405	Cribra orbitalia in the left orbit.
East Smithfield		8365	Cribra orbitalia in the right orbit, with signs of healing (left not present). Healed new bone formation on the endocranial surface of the occipital and parietal.
East Smithfield		11209	Lytic lesion with rounded margins in the right auricular surface.
East Smithfield		11283	Bilateral periosteal reaction on the tibiae.
East Smithfield		11424	Endocranial lesions on parietal and occipital with some evidence of healing.
East Smithfield		11977	Bilateral mild cribra orbitalia.
East Smithfield		12846	Potts spine of thoracic and lumbar vertebrae.
Eynsham Abbey		3	Active cribra orbitalia in left orbit (right not present).
Gloucester Blackfriars		86	Bilateral cribra orbitalia.
Gloucester Blackfriars	148	146	Endocranial lesions on frontal and occipital.
Gloucester Blackfriars		161	Small plaques of new bone formation on the endocranial surface of cranial fragments.
Gloucester Blackfriars		251	Bilateral cribra orbitalia. Periosteal reaction on right tibia.
Gloucester Blackfriars		290	Woven bone with capillary lesions on the endocranial surface of the occipital. Plaques of woven bone on the endocranial surface of the temporal. Woven bone around foramen on sphenoid parietals show faint capillary lesions faint through extensive remodelling. Bilateral porosity on the anterior medial surface of the tibiae.
Gloucester Blackfriars		354	Endocranial lesions on occipital.
Gloucester Blackfriars		402	Bilateral woven bone on anterior medial surface of tibiae both displaying striation and porosity.
Gloucester Blackfriars		182 c	Bilateral active cribra orbitalia. Increased porosity & new bone formation superior to the external auditory meatus. Enamel hypoplasia (possibly cuspal). Also caries on the mesial surface on deciduous mandibular 2nd molar. Also carious lesions on the maxillary molars including large one between the maxillary left M1 (distally) and M2 (mesially).
Guildhall Yard		13110	Endocranial lesions on the occipital and right temporal posterior to the petrous portion.
Guildhall Yard		20533	Enthesophyte on the anterior mesial distal surface of the right humerus.
Guildhall Yard		20619	Bilateral cribra orbitalia. Endocranial lesion on frontal.
Hereford Cathedral		89	Mild cribra orbitalia in right orbit (left not present).
Hereford Cathedral		289	Caries on deciduous maxillary right incisors.

Site Name	Burial	Skeleton	Pathology
Hereford Cathedral		467	Possible new bone formation on the anterior medial surface of both tibiae.
Hereford Cathedral		532	The basilar portion has split on the right side viewed from superiorly there appears to be a radiating fissure from a hole or foramen. Viewed from the right side the fissure cuts between anterior and posterior with anterior portion appearing to be out of line/ elevated.
Hereford Cathedral		708	Bilateral mild cribra orbitalia showing signs of remodelling. Endocranial lesions; the occipital has deep channel appearance of woven bone but with some evidence of healing. New bone formation on the temporal bones on the squamous portion anterior to the petrous again with signs of remodelling. The parietals have healed plaques of new bone formation almost completely remodelled. The frontal has remodelled new bone. The sphenoid has plaques of new bone on the superior surfaces partially around the foramen. Woven bone on the mandible at first permanent molar and on the maxilla at the gum line.
Hereford Cathedral		864	Periosteal reaction on the distal tibiae, bilateral but the left tibiae shows remodelling with linear striations on the anterior medial surface and smooth on posterior surface. The right tibia shows linear striations on the anterior medial surface and active new bone formation on the posterior surface distally.
Hereford Cathedral		950	Bilateral cribra orbitalia.
Hereford Cathedral		1071	Cuspal enamel hypoplasia on dentition?
Hereford Cathedral		1342	Bilateral mild cribra orbitalia with remodelling. Plaque of new bone formation on the endocranial surface of parietals (bilateral) anterior to the petrous portion. The right parietal also has new bone formation on the ectocranial surface superior to the meatus.
Hereford Cathedral		1527	Cribra orbitalia in the left orbit (right not present).
Hereford Cathedral		1533	Bilateral active cribra orbitalia.
Hereford Cathedral		2376	Woven bone on the endocranial surface of the frontal and parietals.
Hereford Cathedral		2926	Cribra orbitalia in right orbit (left not present). Woven bone on the exterior surface of the left temporal (right not present) superior to the mastoid process and external auditory meatus.
Hereford Cathedral		2932	Bilateral mild cribra orbitalia
Hereford Cathedral		4059	Cribra orbitalia in left orbit (right not present). Healed new bone formation on the endocranial surface of the occipital. Possible new bone formation on the ectocranial surface of the occipital. Two circular holes in left portion of the occipital with rounded margins on the endocranial surface suggesting healed pathology rather than taphonomic.
Hereford Cathedral		4094	Endocranial lesions on the occipital, but with evidence of healing.
Hereford Cathedral		4160	Bilateral active cribra orbitalia. Caries on maxillary dentition.
Hereford Cathedral		4423	Occipital has sub circular non-perforating hole on the endocranial surface (does not extend to the ectocranial surface) hole has defined margin / lip that is lighter in colour to surrounding bone & new bone growth surrounds area suggesting perhaps not taphonomic.
Huntington Orchard Lane		1100	Mild cribra orbitalia in right orbit (left not present) with some remodelling. Plaque of new bone formation on the endocranial surface of the frontal. Very rugged muscle attachments on the anterior and medial proximal right humerus.
Huntington Orchard Lane		1125	Endocranial lesions on occipital with extensive remodelling.
Market Street, Winchester	G182	806	Endocranial lesions on the occipital with some remodelling and on the endocranial surface of the right temporal.
New Romney	2	51	Bilateral cribra orbitalia.
New Romney	8	165	Bilateral cribra orbitalia. New bone formation on anterior surface of the lesser wings of sphenoid. Abnormal shape to mandibular ramus with the gonion region appearing crushed and the ramus twisted and flattened.
New Romney	43	543	Bilateral cribra orbitalia. Woven bone formation on superior surface of lesser wings of sphenoid. New bone formation on endocranial surface of cranium including woven bone formation on the endocranial surface of the frontal with some evidence of vascularisation. Vascular impressions on the endocranial surface of occipital. Mild porosity on ectocranial surface of greater wing of sphenoid.

Site Name	Burial	Skeleton	Pathology
St Benet Sherehog		996	Bilateral cribra orbitalia. Caries below the gum line on both maxillary and mandibular teeth but more severe on mandibular.
St Benet Sherehog		1610	Bilateral periosteal reaction on both femurs and both tibiae interiorly proximally.
St Nicholas Shambles		5129	Bilateral cribra orbitalia
St. Mary Graces		13711	Woven bone formation on basilaris & temporals.
St. Mary Graces		13805	Possible new bone formation on anterior medial surface of both tibiae.
St. Mary Graces		16081	Plaque of new bone formation on the anterior surface of the right frontal.
St. Mary Graces		16119	Active cribra orbitalia in left orbit (right orbit fragmented).
St. Oswalds, Gloucester		13	Bilateral active cribra orbitalia. Endocranial lesion on the frontal bone. New bone formation on posterior of left humerus.
Stonar		12	Cribra orbitalia in the right orbit. Deep vascular impressions on the endocranial surface of the right frontal (left not present). Possible twisting of the right tibia (left not present).
Stonar		14	Endocranial lesions on the occipital.
Stonar		28	Endocranial lesions on occipital, frontal and the superior surface of the greater wing of the sphenoid.
Stonar		49	Bilateral cribra orbitalia. Endo cranial lesions on the frontal. Plaque of new woven bone on the superior surface of the 2nd left rib.
Stonar		55	Endocranial lesions on the occipital.
Stonar		60	Bilateral cribra orbitalia. Cemetum on dentition.
Stonar		74	Bilateral cribra orbitalia
Stonar		77	Bilateral cribra orbitalia. Endo cranial lesions with extensive capillary lesions on the frontal, parietals and occipital. Porosity on the inferior surface of the sphenoid.
Stonar		88	Bilateral mild cribra orbitalia.
Stonar		106	Periosteal bone reaction all long bones which appear 'stumpy' i.e. too wide for length. Enthesophyte on the anterior surface of the humerus and proximal radius. Enlarged foramen.
Stonar		110	Endocranial lesion on the occipital. Enthesophyte/ periosteal reactive bone on the right humerus ulna and radius (left arm and leg bones missing).
Stonar		111	New bone formation and porosity on the ectocranial surface of the right temporal. Bilateral woven bone on proximal humeri.
Stonar		112a	Bilateral cribra orbitalia
Stonar		24b	Bilateral active cribra orbitalia. Porosity on the inferior surface of the greater wings of the sphenoid. Porosity on the maxilla. Porosity on the temporals superior to the external auditory meatus, plaque of woven bone on the endocranial surface of the right temporal. Compact bone on the endocranial surface of the frontal (some vascularisation but mainly completely remodelled). Plaque of new bone formation on the proximal distal right ulna. Bilateral porosity on the scapulars. Bilateral periosteal reaction on the lateral and medial surfaces of the tibiae.
Stonar		42b	Bilateral cribra orbitalia but healed in right orbit and extensive in left orbit. New bone formation and vascularisation on the inferior surface of the greater wing of the sphenoid. New bone formation and porosity on ectocranial surface of the right temporal superior to auditory meatus (left not present).
Stonar		97c	Bilateral cribra orbitalia

Appendix 10: Sex distribution of pathological individuals on each site.

Early Anglo-Saxon

Site	Total number of aged individuals	Pathological Individuals						
		Total	Undetermined	Indeterminate	Female	Male	χ^2	P=
Alton, Mount Pleasant	6	1	0	0	0	1	1.00	0.317
Barrington Edix Hill	2	0	0	0	0	0		
Beacon Hill	2	0	0	0	0	0		
Bradstow School, Broadstairs	6	1	0	0	0	1	1.00	0.317
Burwell	4	1	0	0	0	1	1.00	0.317
Cannington	76	24	2	5	8	9	0.06	0.808
Dover Buckland	13	0	0	0	0	0		
Droxford	2	0	0	0	0	0		
Eccles	3	1	0	0	0	1	1.00	0.317
Finglesham	15	0	0	0	0	0		
Great Chesterford	88	18	1	5	6	6	0.00	1.000
Henley Wood	5	1	0	0	1	0	1.00	0.317
Holborough	2	0	0	0	0	0		
Lechlade Butler's Field	27	7	0	0	5	2	1.29	0.257
New Wintles	1	0	0	0	0	0		
Portway East	5	0	0	0	0	0		
Queenford Farm	22	6	0	2	3	1	1.00	0.317
Redcastle Furze	3	2	0	2	0	0		
Stanton Harcourt	4	0	0	0	0	0		
Station Road, Gamlingay	20	9	0	5	2	2	0.00	1.000
Watchfield	1	0	0	0	0	0		
Winnall	3	1	0	0	0	1	1.00	0.317
Worthy Park	8	1	0	0	0	1	1.00	0.317
Total	318	73	3	19	25	26	0.02	0.889

Late Anglo-Saxon

Site	Total number of aged individuals	Pathological Individuals						
		Total	Undetermined	Indeterminate	Female	Male	χ^2	P=
Cherry Hinton	201	56	5	8	11	32	10.3	**0.001
Cirencester Abbey	1	1	0	0	1	0	1.00	0.317
Norwich North-East Bailey	37	12	0	5	6	1	3.57	0.059
Nunnaminster	2	0	0	0	0	0		
Raunds	99	67	3	3	27	34	0.80	0.370
Romsey Abbey	8	0	0	0	0	0		
St. Oswalds, Gloucester	11	0	0	0	0	0		
Staple Gardens	26	8	0	0	4	4	0.00	1.000
Total	385	144	8	16	49	71	4.03	*0.045

Medieval

Site	Total number of aged individuals	Pathological Individuals						
		Total	Undetermined	Indeterminate	Female	Male	χ^2	P=
Chichester	57	30	1	3	12	14	0.15	0.695
Cirencester Abbey	5	1	0	0	1	0	1.00	0.317
Clopton	10	0	0	0	0	0		
Comet Place	28	1	0	0	0	1	1.00	0.317
Cuddington	19	2	0	0	1	1	0.00	1.000
East Smithfield	46	8	1	0	4	3	0.14	0.706
Eynsham Abbey	5	1	0	0	0	1	1.00	0.317
Gloucester Blackfriars	22	8	0	0	5	3	0.50	0.480
Guildhall Yard	5	3	0	0	2	1	0.33	0.564
Hereford Cathedral	69	18	0	0	9	9	0.00	1.000
Huntington Orchard Lane	5	2	0	0	1	1	0.00	1.000
Leominster	1	0	0	0	0	0		
Market Street, Winchester	2	1	0	0	0	1	1.00	0.317
New Romney	7	3	0	1	0	2	2.00	0.157
Spital Square	4	0	0	0	0	0		
St Benet Sherehog	3	2	0	1	0	1	1.00	0.317
St Gregory's Priory Canterbury	7	0	0	0	0	0		
St Nicholas Shambles	7	1	0	0	0	1	1.00	0.317
St. John Clerkenwell	2	0	0	0	0	0		
St. Mary Graces	20	4	0	0	2	2	0.00	1.000
St. Oswalds, Gloucester	37	1	0	1	0	0		
Stonar	44	16	0	3	3	10	3.77	0.052
Total	405	102	2	9	40	51	1.33	0.249

Appendix 11: Age and sex distribution of pathologies for each period.

Early Anglo-Saxon		Foetus	Neonate	Infant	1-2 Year Child	2-3 Year Child	3-4 Year Child	4-5 Year Child	5-6 Year Child	Total
Total number of Individuals		78	45	27	68	27	36	20	17	318
Pathological Individuals	Actual	6	15	7	23	6	9	7	0	73
	CPR%	8	33	26	34	22	25	35	0	23
Periosteal Reaction	Actual	3	7	4	4	1	1	2	0	22
	CPR%	4	16	15	6	4	3	10	0	7
Endocranial lesions	Actual	2	6	4	7	3	4	2	0	28
	CPR%	3	13	15	10	11	11	10	0	9
Ectocranial lesions	Actual	0	3	2	7	1	2	1	0	16
	CPR%	0	7	7	10	4	6	5	0	5
Cribra Orbitalia	Actual	1	4	1	11	4	5	5	0	31
	CPR%	1	9	4	16	15	14	25	0	10
Rickets	Actual	0	2	1	1	0	0	1	0	5
	CPR%	0	4	4	1	0	0	5	0	2
Scurvy	Actual	1	2	4	4	1	2	1	0	15
	CPR%	1	4	15	6	4	6	5	0	5
TB	Actual	0	0	0	1	0	0	1	0	2
	CPR%	0	0	0	1	0	0	5	0	1
Caries	Actual	0	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0	0
Enamel hypoplasia	Actual	0	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0	0
Other	Actual	0	0	0	3	0	0	0	0	3
	CPR%	0	0	0	4	0	0	0	0	1

Late Anglo-Saxon		Foetus	Neonate	Infant	1-2 Year Child	2-3 Year Child	3-4 Year Child	4-5 Year Child	5-6 Year Child	Total
Total number of Individuals		71	54	60	67	42	50	29	12	385
Pathological Individuals	Actual	21	19	14	33	11	29	11	6	144
	CPR%	30	35	23	49	26	58	38	50	37
Periosteal Reaction	Actual	11	17	3	7	3	5	2	0	48
	CPR%	15	31	5	10	7	10	7	0	12
Endocranial lesions	Actual	13	9	7	14	6	12	4	3	68
	CPR%	18	17	12	21	14	24	14	25	18
Ectocranial lesions	Actual	2	4	3	11	3	6	4	3	36
	CPR%	3	7	5	16	7	12	14	25	9
Cribra Orbitalia	Actual	4	3	11	22	7	22	8	6	83
	CPR%	6	6	18	33	17	44	28	50	22
Rickets	Actual	0	1	0	2	0	0	0	0	3
	CPR%	0	2	0	3	0	0	0	0	1
Scurvy	Actual	4	3	3	8	3	3	3	1	28
	CPR%	6	6	5	12	7	6	10	8	7
TB	Actual	0	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0	0
Caries	Actual	0	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0	0
Enamel hypoplasia	Actual	0	0	0	0	0	2	0	0	2
	CPR%	0	0	0	0	0	4	0	0	1
Other	Actual	0	0	1	2	2	1	0	2	8
	CPR%	0	0	2	3	5	2	0	17	2

Medieval		Foetus	Neonate	Infant	1-2 Year Child	2-3 Year Child	3-4 Year Child	4-5 Year Child	5-6 Year Child	Total
Total number of Individuals		54	54	39	69	54	62	51	22	405
Pathological Individuals	Actual	6	14	6	23	15	17	12	9	102
	CPR%	11	26	15	33	28	27	24	41	25
Periosteal Reaction	Actual	1	6	1	2	4	4	3	2	23
	CPR%	2	11	3	3	7	6	6	9	6
Endocranial lesions	Actual	4	11	4	13	6	4	3	3	48
	CPR%	7	20	10	19	11	6	6	14	12
Ectocranial lesions	Actual	1	1	2	7	4	4	2	3	24
	CPR%	2	2	5	10	7	6	4	14	6
Cribra Orbitalia	Actual	1	6	1	11	11	14	8	5	57
	CPR%	2	11	3	16	20	23	16	23	14
Rickets	Actual	0	1	0	0	0	0	1	0	2
	CPR%	0	2	0	0	0	0	2	0	0
Scurvy	Actual	1	2	1	1	1	0	1	1	8
	CPR%	2	4	3	1	2	0	2	5	2
TB	Actual	0	0	0	0	0	2	1	1	4
	CPR%	0	0	0	0	0	3	2	5	1
Caries	Actual	0	0	0	1	1	1	1	0	4
	CPR%	0	0	0	1	2	2	2	0	1
Enamel hypoplasia	Actual	0	0	0	1	0	1	0	0	2
	CPR%	0	0	0	1	0	2	0	0	0
Other	Actual	1	0	1	6	1	2	0	0	11
	CPR%	2	0	3	9	2	3	0	0	3

Appendix 12: Prevalence of pathology at each site.

Early Anglo-Saxon Sites		Alton, Mount Pleasant	Barrington Edix Hill	Beacon Hill	Bradstow School, Broadstairs	Burwell	Cannington	Dover Buckland	Droxford
Total number of Individuals		6	2	2	6	4	76	13	2
Pathological Individuals	Actual	1	0	0	1	1	24	0	0
	CPR%	17	0	0	17	25	32	0	0
Periosteal Reaction	Actual	0	0	0	0	0	6	0	0
	CPR%	0	0	0	0	0	8	0	0
Endocranial lesions	Actual	0	0	0	0	0	9	0	0
	CPR%	0	0	0	0	0	12	0	0
Ectocranial lesions	Actual	0	0	0	0	0	7	0	0
	CPR%	0	0	0	0	0	9	0	0
Cribra Orbitalia	Actual	0	0	0	1	0	14	0	0
	CPR%	0	0	0	17	0	18	0	0
Rickets	Actual	0	0	0	0	1	0	0	0
	CPR%	0	0	0	0	25	0	0	0
Scurvy	Actual	0	0	0	0	0	6	0	0
	CPR%	0	0	0	0	0	8	0	0
TB	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Caries	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Enamel hypoplasia	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Other	Actual	1	0	0	0	0	0	0	0
	CPR%	17	0	0	0	0	0	0	0

Early Anglo-Saxon Sites		Eccles	Finglesham	Great Chesterford	Henley Wood	Holborough	Lechlade Butler's Field	New Wintles	Portway East
Total number of Individuals		3	15	88	5	2	27	1	5
Pathological Individuals	Actual	1	0	18	1	0	7	0	0
	CPR%	33	0	20	20	0	26	0	0
Periosteal Reaction	Actual	0	0	10	0	0	1	0	0
	CPR%	0	0	11	0	0	4	0	0
Endocranial lesions	Actual	0	0	4	1	0	3	0	0
	CPR%	0	0	5	20	0	11	0	0
Ectocranial lesions	Actual	0	0	4	0	0	2	0	0
	CPR%	0	0	5	0	0	7	0	0
Cribra Orbitalia	Actual	1	0	8	0	0	2	0	0
	CPR%	33	0	9	0	0	7	0	0
Rickets	Actual	0	0	2	0	0	1	0	0
	CPR%	0	0	2	0	0	4	0	0
Scurvy	Actual	0	0	3	0	0	1	0	0
	CPR%	0	0	3	0	0	4	0	0
TB	Actual	0	0	2	0	0	0	0	0
	CPR%	0	0	2	0	0	0	0	0
Caries	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Enamel hypoplasia	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Other	Actual	0	0	2	0	0	0	0	0
	CPR%	0	0	2	0	0	0	0	0

Early Anglo-Saxon Sites		Queenford Farm	Redcastle Furze	Stanton Harcourt	Station Road, Gamlingay	Watchfield	Winnall	Worthy Park	Early Anglo-Saxon Total
Total number of Individuals		22	3	4	20	1	3	8	318
Pathological Individuals	Actual	6	2	0	9	0	1	1	73
	CPR%	27	67	0	45	0	33	13	23
Periosteal Reaction	Actual	0	1	0	4	0	0	0	22
	CPR%	0	33	0	20	0	0	0	7
Endocranial lesions	Actual	5	2	0	4	0	0	0	28
	CPR%	23	67	0	20	0	0	0	9
Ectocranial lesions	Actual	1	0	0	2	0	0	0	16
	CPR%	5	0	0	10	0	0	0	5
Cribra Orbitalia	Actual	1	0	0	2	0	1	1	31
	CPR%	5	0	0	10	0	33	13	10
Rickets	Actual	0	0	0	1	0	0	0	5
	CPR%	0	0	0	5	0	0	0	2
Scurvy	Actual	1	0	0	2	0	0	0	13
	CPR%	5	0	0	10	0	0	0	4
TB	Actual	0	0	0	0	0	0	0	2
	CPR%	0	0	0	0	0	0	0	1
Caries	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Enamel hypoplasia	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Other	Actual	0	0	0	0	0	0	0	3
	CPR%	0	0	0	0	0	0	0	1

Late Anglo-Saxon Sites		Cherry Hinton	Cirencester Abbey	Norwich North-East Bailey	Nunnaminster	Raunds	Romsey Abbey	St. Oswalds, Gloucester	Staple Gardens	Total
Total number of Individuals		201	1	37	2	99	8	11	26	385
Pathological Individuals	Actual	56	1	12	0	67	0	0	8	144
	CPR%	28	100	32	0	68	0	0	31	37
Periosteal Reaction	Actual	10	1	0	0	37	0	0	0	48
	CPR%	5	100	0	0	37	0	0	0	12
Endocranial lesions	Actual	26	0	5	0	37	0	0	0	68
	CPR%	13	0	14	0	37	0	0	0	18
Ectocranial lesions	Actual	13	1	2	0	19	0	0	1	36
	CPR%	6	100	5	0	19	0	0	4	9
Cribra Orbitalia	Actual	34	0	8	0	35	0	0	6	83
	CPR%	17	0	22	0	35	0	0	23	22
Rickets	Actual	0	0	0	0	3	0	0	0	3
	CPR%	0	0	0	0	3	0	0	0	1
Scurvy	Actual	12	0	2	0	14	0	0	0	28
	CPR%	6	0	5	0	14	0	0	0	7
TB	Actual	0	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0	0
Caries	Actual	0	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0	0
Enamel hypoplasia	Actual	0	0	0	0	1	0	0	1	2
	CPR%	0	0	0	0	1	0	0	4	1
Other	Actual	2	1	0	0	3	0	0	2	8
	CPR%	1	100	0	0	3	0	0	8	2

Medieval Sites		Chichester	Cirencester Abbey	Clopton	Comet Place	Cuddington	East Smithfield	Eynsham Abbey	Gloucester Blackfriars
Total number of Individuals		57	5	10	28	19	46	5	22
Pathological Individuals	Actual	30	1	0	1	2	8	1	8
	CPR%	53	0	0	4	11	17	20	36
Periosteal Reaction	Actual	9	0	0	0	0	1	0	3
	CPR%	16	0	0	0	0	2	0	14
Endocranial lesions	Actual	17	0	0	1	1	1	0	4
	CPR%	30	0	0	4	5	2	0	18
Ectocranial lesions	Actual	12	0	0	0	1	1	0	1
	CPR%	21	0	0	0	5	2	0	5
Cribra Orbitalia	Actual	17	0	0	1	1	4	1	3
	CPR%	30	0	0	4	5	9	20	14
Rickets	Actual	1	0	0	0	0	0	0	0
	CPR%	2	0	0	0	0	0	0	0
Scurvy	Actual	5	0	0	0	1	0	0	0
	CPR%	9	0	0	0	5	0	0	0
TB	Actual	2	0	0	0	0	1	0	0
	CPR%	4	0	0	0	0	2	0	0
Caries	Actual	0	0	0	0	0	0	0	1
	CPR%	0	0	0	0	0	0	0	5
Enamel hypoplasia	Actual	0	0	0	0	0	0	0	1
	CPR%	0	0	0	0	0	0	0	5
Other	Actual	2	0	0	1	0	1	0	0
	CPR%	4	0	0	4	0	2	0	0

Medieval Sites		Guildhall Yard	Hereford Cathedral	Huntington Orchard Lane	Leominster	Market Street, Winchester	New Romney	Spital Square	St Benet Sherehog
Total number of Individuals		5	69	5	1	2	7	4	3
Pathological Individuals	Actual	3	18	2	0	1	3	0	2
	CPR%	80	26	40	0	50	43	0	67
Periosteal Reaction	Actual	0	2	0	0	0	0	0	1
	CPR%	0	3	0	0	0	0	0	33
Endocranial lesions	Actual	3	5	2	0	1	2	0	0
	CPR%	60	7	40	0	50	29	0	0
Ectocranial lesions	Actual	0	4	0	0	0	1	0	0
	CPR%	0	6	0	0	0	14	0	0
Cribra Orbitalia	Actual	2	10	1	0	0	3	0	1
	CPR%	40	14	20	0	0	43	0	33
Rickets	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Scurvy	Actual	0	0	0	0	0	1	0	0
	CPR%	0	0	0	0	0	14	0	0
TB	Actual	0	0	0	0	0	0	0	0
	CPR%	0	0	0	0	0	0	0	0
Caries	Actual	0	2	0	0	0	0	0	1
	CPR%	0	3	0	0	0	0	0	33
Enamel hypoplasia	Actual	0	1	0	0	0	0	0	0
	CPR%	0	1	0	0	0	0	0	0
Other	Actual	1	4	1	0	0	1	0	0
	CPR%	20	6	20	0	0	14	0	0

Medieval Sites		St Gregory's Priory Canterbury	St Nicholas Shambles	St. John Clerkenwell	St. Mary Graces	St. Oswalds, Gloucester	Stonar	Medieval Total
Total number of Individuals		7	7	2	20	37	44	405
Pathological Individuals	Actual	0	1	0	4	1	16	102
	CPR%	0	14	0	20	3	36	25
Periosteal Reaction	Actual	0	0	0	1	1	5	23
	CPR%	0	0	0	5	3	11	6
Endocranial lesions	Actual	0	0	0	1	1	9	48
	CPR%	0	0	0	5	3	20	12
Ectocranial lesions	Actual	0	0	0	1	0	3	24
	CPR%	0	0	0	5	0	7	6
Cribra Orbitalia	Actual	0	1	0	1	1	10	57
	CPR%	0	14	0	5	3	23	14
Rickets	Actual	0	0	0	0	0	1	2
	CPR%	0	0	0	0	0	2	0
Scurvy	Actual	0	0	0	0	0	1	8
	CPR%	0	0	0	0	0	2	2
TB	Actual	0	0	0	0	0	1	4
	CPR%	0	0	0	0	0	2	1
Caries	Actual	0	0	0	0	0	0	4
	CPR%	0	0	0	0	0	0	1
Enamel hypoplasia	Actual	0	0	0	0	0	0	2
	CPR%	0	0	0	0	0	0	0
Other	Actual	0	0	0	0	0	1	12
	CPR%	0	0	0	0	0	2	3